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## HEALTH AND SAFETY PLAN

*MAC PRODUCTS, INC.*

60 PENNSYLVANIA AVENUE

KEARNY, HUDSON COUNTY, NEW JERSEY

USEPA REGISTRY ID #110004259533

**Prepared for:**

*MAC PRODUCTS, INC.*

60 PENNSYLVANIA AVENUE

KEARNY, NEW JERSEY 07032

**Prepared by:**

*EIKON PLANNING AND DESIGN, LLC*

221 HIGH STREET

HACKETTSTOWN, NEW JERSEY 07840

908-813-2323

**JULY 2014**

**HEALT AND SAFETY PLAN**  
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## **1.0 INTRODUCTION**

This Health and Safety Plan (HASP) has been prepared for general guidance and compliance with federal and state health and safety requirements during the implementation of targeted remedial actions at the subject property. The purpose of this HASP is to define the general procedures, practices and equipment to be used by site personnel during the course of the project to protect the health and safety of project personnel.

This HASP is based on safety standards as defined by the United States Environmental Protection Agency (USEPA), Occupational Safety and Health Administration (OSHA), National Institute of Occupational Safety and Health (NIOSH) and the New Jersey Department of Environmental Protection (NJDEP).

A review of the HASP will be presented by the Site Safety and Health Officer (SSHO) to field personnel/site workers, if and as deemed prudent, to ensure that personnel understand and comply with the outlined procedures. Please note, this HASP specifically applies to the project and tasks outlined herein and to the workers involved in the implementation of said project/tasks and is not intended to apply to internal MAC Products employees or MAC Products operating procedures.

## **2.0 HAZARD ANALYSIS AND SITE RISK**

The following information outlines the general characteristics of the subject property and the environmental hazards and site risks to onsite personnel implementing the remedial actions.

**Site:** *MAC Products Facility*  
**60 Pennsylvania Avenue**  
**Kearny, Hudson County, New Jersey**

**Property Description:** The subject property is developed with three primary structures, designated herein as Buildings A, B and C. MAC Products designs and constructs electric utility products for various businesses. The areas around the buildings generally consist of paved parking lots and driveways.

**Contaminants:** Due to concerns posed by volatile organic compounds (VOCs) identified in groundwater at an adjacent property to the MAC Products site, a vapor intrusion (VI) investigation study was performed for Buildings A, B and C, including the collection of sub-slab soil gas (SSSG) and two rounds of indoor air (IA) samples. A potential/existing VI pathway was identified within Building B for select VOCs, including:

- naphthalene;
- 1,4-dichlorobenzene (1,4DCB); and
- trichloroethene (TCE).

Information pertaining to the contaminants of concern, including OSHA exposure limits, USEPA hazard summaries and NIOSH chemical hazard details are provided in Attachment 1.

**Operations/Job Hazard Analysis (JHA):** The remedial actions, which may be modified by the HSS if and as needed, are to include:

- implementation of a baseline diagnostic test to evaluate air flow/communication below the floor of Building B via the installation of multiple suction sumps and monitoring points;
- installation of multiple sub-slab depressurization systems (SSDS) within Building B using various hand tools and mechanical equipment, including limited concrete and soil removal;
- operation and maintenance of the SSDS, including implementation of various system commissioning events;
- collection of post-mitigation IA samples;
- generation, handling, characterization and disposal of derived waste materials (e.g., concrete, soil, etc.); and
- site restoration.

The remedial actions do not include any confined space entry procedures, hot work or lockout/tagout activities.

**Contaminant Pathways/Hazards:** Expected exposure and risks to personnel implementing the remedial actions may include:

- skin contact with contaminated soil and/or concrete;
- inhalation exposure to VOCs;
- slips, trips and falls;
- noise exposure (levels exceeding 90 DBA); and
- heat or cold stress (weather concerns).

### **3.0 ORGANIZATIONAL STRUCTURE**

Key personnel involved in the remedial action project include:

- Project Manager (PM): Vince Pappalardo, Eikon Planning & Design, LLC (Eikon)  
The PM has responsibility and authority to direct all work operations. The PM coordinates safety and health functions with the Site Safety and Health Officer and bears ultimate responsibility for the proper implementation of the HASP.
- Health and Safety Supervisor (HSS): Vince Pappalardo, Eikon  
Responsible for preparation and review of HASP, communicating with Client, providing consultation on health and safety issues and approving any modifications to the HASP.
- Site Safety and Health Officer (SSHO): Adam Divine, Eikon  
Responsible for coordinating the project, assigning qualified personnel for each task, conducting periodic reviews of the HASP, ensuring implementation of the HASP by field personnel and communicating with the HSS. The SSHO has the responsibility and authority to abate unsafe operations if and when they arise. The SSHO will conduct initial and periodic inspections to identify site hazards and ensure proper use of PPE.
- Emergency Response Coordinator (ERC): Adam Divine, Eikon  
Responsible for assessing site conditions, directing and controlling emergency response activities, including evacuation, emergency transport and treatment of site personnel.
- Site Workers:  
As required, site personnel will meet the training requirements of the OSHA Standards 29 Code of Federal Regulations (CFR) 1910.120 before entering areas where remedial actions occur. Site workers are responsible for complying with this HASP, using proper PPE, reporting unsafe acts and/or conditions and following the instructions of the PM, HSS, SSHO and ERC.

#### **4.0 TRAINING REQUIREMENTS FOR ONSITE PERSONNEL**

All workers engaged in the remedial action project shall have met one of the following requirements prior to the start of operations at the site:

1. General site workers engaged in hazardous substance removal or other activities that expose or potentially expose workers to hazardous substances and health hazards, shall receive a minimum of 40 hours of instruction off the

site and a minimum of 3 days actual field experience under the direct supervision of a trained, experienced supervisor.

2. Workers onsite only occasionally for a specific limited task and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and a minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.
3. Workers regularly onsite, who work in areas that have been monitored and are fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site, and a minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.
4. Workers with 24 hours of training who are covered by paragraphs 2. and 3. of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and 2 days of training necessary to total the training specified in Paragraph 1 of this section.
5. In addition, an annual 8-hour refresher course after the initial training shall be provided to all field personnel.

Onsite management and supervisors directly responsible for or who supervise employees engaged in the project, including the onsite HSO, shall also have received 8 hours additional training in managing such site operations prior to the start of site activities as stipulated in 29 CFR 1910.120.

All project employees who may be required to use respiratory protection will be required to participate in a respirator fit training program, which covers fit testing and proper respirator selection.

Onsite safety training will consist of safety briefing(s) prior to the beginning of any field work. This meeting will review site-specific known and suspected contaminants and cover all site-specific activities and will also review the site emergency response plan. Site workers and managers are required to attend this meeting and to confirm their attendance via the Daily Review and Sign-In Sheet (refer to Attachment 2).

## **5.0 PERSONAL PROTECTIVE EQUIPMENT**

The following is a description of the necessary equipment to be used at the site in association with the remedial action project:

### Level D:

- Regular Tyvek coveralls (as necessary)
- Chemical resistant gloves (as necessary)
- Safety boots with steel toe and shank (as necessary)
- Hard hat (as necessary)
- Hearing protection (as necessary)
- Safety Glasses (as necessary)

### Level C:

- Basic site equipment (Level D)
- Chemical resistant clothing and overboots
- Surgical inner gloves
- Nitrile outer gloves (taped to Tyvek)
- NIOSH/MSHA Approved Respiratory Protection (Air-Purifying respirator)

### Level B:

- Basic site equipment (Level D)
- Hooded chemical resistant clothing and overboots
- Surgical inner gloves
- Nitrile outer gloves
- NIOSH/MSHA Approved Respiratory Protection (Supplied air respirator)

Based upon the background information on the site, it is anticipated that work will primarily be conducted under Level D conditions, with potential upgrade to Level C, if and as deemed necessary by the SSHO and/or HSS.

Level C respiratory protection, using organic vapor/acid gas cartridges, if and as deemed necessary, will be donned when air monitoring indicates the need for respiratory protection. The photoionization detector (PID) will be the primary instrument for determining contaminant concentrations, which may trigger a change in respiratory protection. Respirators should be inspected and cleaned each day prior to usage. For supplied air respirators inspect connections, check regulators and valves, alarms and check face shield for any cracks, large scratches and fogging.

Respirator cartridges should be supplied for the type of respirator and the type of contaminants to be found at the site. The organic vapor/acid gas cartridges will be used during Level C activities onsite. During times of heavy humidity, the effectiveness of the cartridges is reduced, so the need to change cartridges increases. Cartridges should be changed daily if usage is minimal. If respirators are being used all day, cartridges should be changed more frequently, as needed.

## **6.0 MEDICAL SURVEILLANCE**

Project personnel required to work in restricted areas will participate in an appropriate medical surveillance program in accordance with 29 CFR 1910.120(f), including:

- a medical examination once every twelve months;
- a medical examination at termination or initiation of employment; and
- a medical examination upon development of symptoms indicating possible exposure to hazardous substances.

## **7.0 SITE CONTROL**

Appropriate employee protection measures will be implemented to provide for the protection of the project employees and the environment, including:

- Delineation of work zones, if and as needed, for specific work phases into three areas:
  - Exclusion (Contaminated) Zone
  - Contamination Reduction Zone
  - Support (Clean) Zone
- Conducting a Pre-Work Safety Review

Site security is to be managed by the SSHO. Security shall be maintained to prevent unauthorized entry to the work zone and removal of contaminated material. A site map is included herein as Figure 1.

A Notice in the form included as Attachment 5 to the VI Mitigation Plan, shall be posted in the location within the facility where employee information is posted. Additional information can be made available upon request.

## **8.0 DECONTAMINATION**

Personnel and equipment exiting heavily or materially contaminated areas shall be decontaminated prior to leaving the site to prevent contamination from being transferred into clean areas or exposing unprotected personnel. Project personnel shall be instructed to remove their contaminated work clothing in a specific area and deposit them into designated containers. All project equipment will be properly decontaminated in the contamination reduction zone, including steam cleaning, if and as deemed necessary. Rinse water will be collected and containerized, pending proper offsite disposal.

## **9.0 EMERGENCY RESPONSE PLAN**

The Emergency Response Plan shall be kept at the site and the list of emergency telephone numbers and directions to the nearest hospital will be made available to site personnel. Directions to the nearest hospital are attached.

On site emergencies can range from minor cuts and scrapes to explosions, fires, and the release of toxic gases. Incidents shall be reported to the SSHO, who will determine the appropriate steps to be taken.

When the incident is minor, work may continue following resolution of the incident. When an accident is considered serious, work shall be discontinued until the emergency situation has been brought under control, the incident has been evaluated, and conditions which may have contributed to the emergency have been mitigated.

Site incidents, will be investigated and documented, using Incident Report Forms and Incident Follow-Up Report Forms.

### **9.1 Emergency Recognition and Prevention**

A first aid kit large enough to accommodate anticipated emergencies will be kept on-site. If an injury should require advanced medical assistance, the injured party will be transported to the hospital. Personnel involved in hazardous work on the site will be participating in a medical surveillance program which meets the criteria set forth in OSHA 29 CFR Part 1910.120.

Emergency situations can be prevented or limited by implementing the following measures:

- Using prescribed PPE during onsite activities;

- Using proper personal hygiene practices;
- Sources of ignition shall be kept away from the work area to the extent possible and a fire extinguisher shall be kept onsite;
- Work shall be temporarily halted during times of inclement weather, if said weather shall be a material factor in the operations;
- Absorbent materials, shovels and containers shall be kept onsite to contain spills/leaks.

## **9.2 Evacuation Routes**

In the event of an incident that could potentially expose site personnel or the public to hazardous materials or adverse conditions, the SSHO shall:

- Evacuate all personnel from the area where the material/adverse exposure exists;
- Cease site operations until the risk is addressed;
- Provide medical treatment for injured or exposed personnel; and
- Notify the appropriate agencies for response to the incident, if and as required.

Safe distances and places of refuge in the event of evacuation shall be dependent on wind direction and the type of incident. Personnel will be advised to move to an upwind location a safe distance from any fires and/or chemical releases.

## **9.3 Emergency Medical Treatment**

In the event of injury, personnel shall assemble at pre-arranged areas. If the injured person is immobile, one or more persons shall remain nearby to provide first aid. If medical assistance is required, the SSHO shall contact the appropriate assistance and arrange for transportation of the injured to a medical facility.

The following procedures may be used for overt personnel exposure:

- Skin/Eye Contact: Wash/rinse affected area;
- Inhalation: Get to fresh air, artificial respiration, if and as necessary; and
- Ingestion: Transport to medical facility, if and as necessary.

**Directions to Hospital:** Jersey City Medical Center – 355 Grand Street, Jersey City, NJ 07302 (see Figure 2)

- Head east on Pennsylvania Ave toward Jacobus Ave;
- Take ramp onto US-1 Truck/US-9 Truck N;
- Continue onto Commuipaw Ave; and
- Turn left onto Grand St. – hospital on left.

#### **9.4 Emergency Telephone Numbers**

Emergency telephone numbers for medical and chemical emergencies are provided below:

Ambulance/EMS:	911
Police Department:	911
Fire Dept:	911
NJ State Police Air Medical:	(800) 332-4356
Hospital: Jersey City Medical Center	(201) 915-2000
Poison Control:	(800) 424-9300
NJDEP Hotline:	(877) 927-6337
National Response Center	(800) 424-8802
Eikon Planning and Design, LLC	(908) 813-2323
Stericycle Environmental Services	(732) 424-1998

#### **10.0 EXCAVATION AND TRENCHING**

Excavation work, if required, shall comply with 29 CFR 1926, Subpart P and other applicable state and federal regulations governing excavations and trenching. Excavations shall be performed in the following manner:

- Sloping, Shoring and Benching: Appropriate sloping and benching systems shall be utilized based upon soil type, size of excavation and duration of open excavation, as identified under 29 CFR 1926, Subpart P, Appendix B.
- Exposure to Falling Loads: Employees shall not be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand a safe distance away from any vehicle being loaded or unloaded.

- Egress: A stairway, ladder, ramp or other safe means of egress shall be located in excavations that are 4 feet or more in depth.
- Overhead Electric: Measures shall be taken to avoid overhead electric lines in accordance with 29 CFR 1910, Subpart S and 29 CFR 1926, Subpart K. If contractors cannot keep a safe distance from the power lines, they shall call the appropriate utility company for assistance.
- Utility Markout: Utility companies shall be contacted within established response times, advised of the proposed work and asked to establish the location of the public utility underground installations prior to the start of actual excavation. No ground intrusive work is to commence without a current public underground utility markout.

The One-Call system (1-800-727-1000) shall be notified before digging. Other means of locating underground utilities must be identified for utilities not covered by One-Call system.

## **11.0 THERMAL STRESS**

Work practices and exposure controls shall be used to reduce the risk of heat or cold stress (i.e., elevating or lowering of a worker's core body temperature). The SSHO shall be responsible for implementing thermal stress prevention controls. Said controls may include:

- alternative work schedules;
- employee work/rest intervals;
- monitoring for signs of stress;
- a liquid replacement program; and/or
- cooling/warming garments or other PPE.

Workers receive general training regarding thermal stress-related injuries and illness during HAZWOPER training.

**FIGURE 1**

Figure 1 - Site Location Map  
MAC Products, Inc. Facility

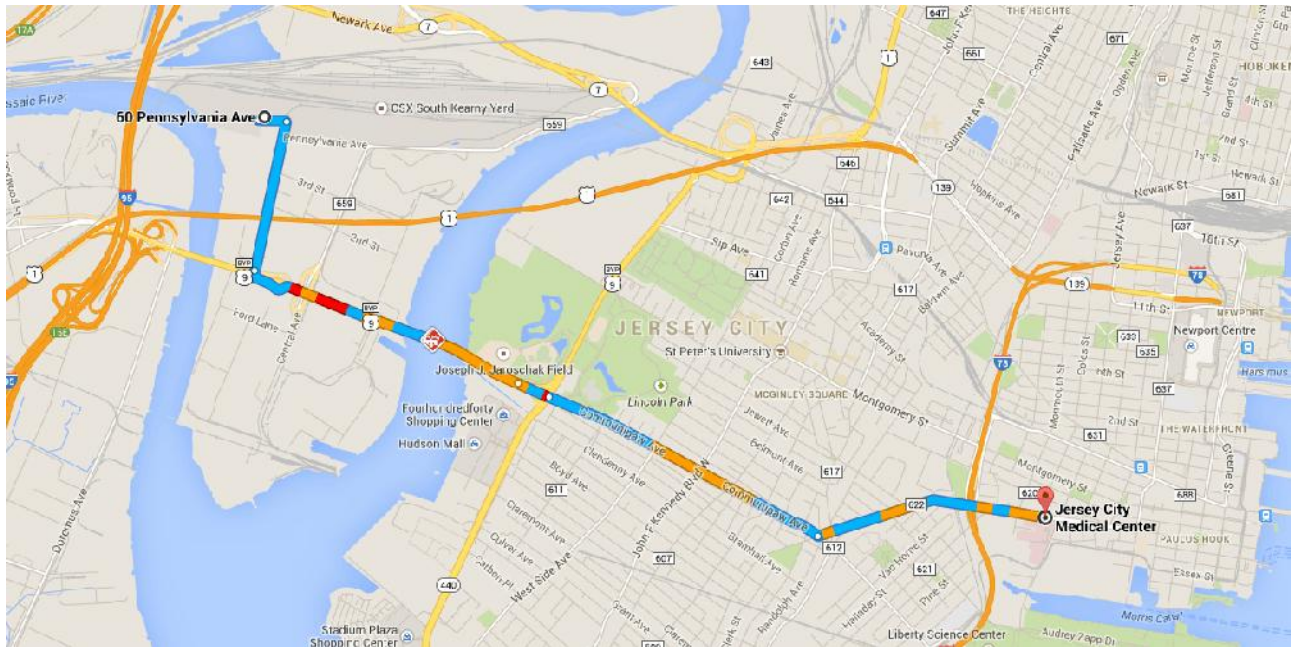


**FIGURE 2**



Drive 4.4 miles, 12 min

## Directions from 60 Pennsylvania Ave to Jersey City Medical Center



## ○ 60 Pennsylvania Ave

Kearny, NJ 07032

- ↑

1. Head **east** on **Pennsylvania Ave** toward **Jacobus Ave**

0.1 mi
- ↑

2. **Pennsylvania Ave** turns **right** and becomes **Jacobus Ave**

0.6 mi
- ↑

3. Take the ramp onto **US-1 Truck N/US-9 Truck N**

1.2 mi
- ↗

4. Slight **right** to stay on **US-1 Truck N/US-9 Truck N**

0.1 mi
- ↑

5. Continue onto **Communipaw Ave**

1.3 mi
- ↶

6. Turn **left** onto **Grand St**

1.0 mi

Destination will be on the left

## ⊙ Jersey City Medical Center

355 Grand St, Jersey City, NJ 07302

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Map data ©2014 Google

**ATTACHMENT 1**



OSHA

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## Naphthalene

### General Description

**Synonyms:** Naphthalin; Naphthaline; Naphthene**OSHA IMIS Code Number:** 1810**Chemical Abstracts Service (CAS) Registry Number:** 91-20-3**NI OSH Registry of Toxic Effects of Chemical Substances (RTECS) Identification Number:**  
[QJ0525000](#)**Department of Transportation Regulation Number (49 CFR 172.101) and 2012 Emergency Response Guidebook [4 MB PDF, 392 pages]:** 1334 133 (crude or refined); 2304 133 (molten)**NI OSH Pocket Guide to Chemical Hazards - [Naphthalene](#):** Physical description, chemical properties, potentially hazardous incompatibilities, and more**U.S. Environmental Protection Agency (EPA) Hazard Summary - [Naphthalene](#):** Uses, sources and potential exposure, acute and chronic health hazard information, and more

### Exposure Limits and Health Effects

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
<b>OSHA Permissible Exposure Limit (PEL) - General Industry</b> See <a href="#">29 CFR 1910.1000 Table Z-1</a>	10 ppm (50 mg/m <sup>3</sup> ) TWA	HE3	Cataracts, jaundice, bloody urine, kidney and liver damage
		HE7	Headache, tiredness, confusion Target organs: Brain, central nervous system
		HE12	Hemolytic anemia
		HE14	Marked eye and skin irritation
<b>OSHA PEL - Construction Industry</b> See <a href="#">29 CFR 1926.55 Appendix A</a>	10 ppm (50 mg/m <sup>3</sup> ) TWA	HE3	Cataracts, jaundice, bloody urine, kidney and liver damage
		HE7	Headache, tiredness, confusion Target organs: Brain, central nervous system
		HE12	Hemolytic anemia
		HE14	Marked eye and skin irritation
<b>OSHA PEL - Shipyard Employment</b> See <a href="#">29 CFR 1915.1000 Table Z-Shipyards</a>	10 ppm (50 mg/m <sup>3</sup> ) TWA	HE3	Cataracts, jaundice, bloody urine, kidney and liver damage
		HE7	Headache, tiredness, confusion Target organs: Brain, central nervous system
		HE12	Hemolytic anemia
		HE14	Marked eye and skin irritation Target organs: Eyes, skin
<b>National Institute for Occupational Safety and Health (NI OSH) Recommended Exposure Limit (REL)</b>	10 ppm (50 mg/m <sup>3</sup> ) TWA	HE3	Jaundice, blood in urine, renal shutdown, optical neuritis, corneal damage
	15 ppm (75 mg/m <sup>3</sup> ) STEL	HE7	Headache, confusion, excitement Target organs: Brain, central nervous system
		HE14	Eye irritation
<b>American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2001)</b>	10 ppm (52 mg/m <sup>3</sup> ) TWA	HE3	Ocular toxicity (cataracts, optical neuritis, lens opacities, retinal degeneration), jaundice, renal failure
	15 ppm (79 mg/m <sup>3</sup> ) STEL	HE7	Headache Target organs: Brain, central nervous system

**Chemical Sampling Information (CSI)****Search** (use word(s)/phrase) [Table of Contents](#)**By Name**[A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#)  
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[OSHA Occupational Chemical Database](#)

	Skin; A4	HE12	Hemolytic anemia
		HE14	Marked eye and respiratory tract irritation
<a href="#">CAL/ OSHA PELs</a>	10 ppm (50 mg/m <sup>3</sup> ) TWA	HE3	Ocular toxicity (cataracts, optical neuritis, lens opacities, retinal degeneration), jaundice, renal failure
	15 ppm (75 mg/m <sup>3</sup> ) STEL	HE7	Headache Target organs: Brain, central nervous system
		HE12	Hemolytic anemia
		HE14	Marked eye and respiratory tract irritation

\*In the ACGIH 2012 Notice of Intended Changes, ACGIH proposed the following limit values and notations: 5 ppm TWA; No STEL; Skin; A3; basis: upper respiratory tract irritation

**National Toxicology Program (NTP) carcinogenic classification:** [Reasonably anticipated to be a human carcinogen](#) [144 KB PDF, 3 pages]

**International Agency for Research on Cancer (IARC) carcinogenic classification:** [Group 2B](#) [70 KB PDF, 21 pages] (possibly carcinogenic to humans)

**EPA carcinogenic classification:** [Carcinogenic potential cannot be determined](#)

**EPA Inhalation Reference Concentration (RfC):** [3x10<sup>-3</sup> mg/m<sup>3</sup>](#)

**Agency for Toxic Substances and Disease Registry (ATSDR) Inhalation Minimal Risk Level (MRL):** [0.0007 ppm \(chronic\)](#)

**NI OSH Immediately Dangerous to Life or Health (IDLH) concentration:** [250 ppm](#)

#### Notes on Other Potential Health Effects and Hazards

1. EPA's oral reference dose (daily oral exposure likely to be without an appreciable risk of deleterious effects during a lifetime) for naphthalene is 0.02 mg/kg/day (EPA 2000).
2. At least one study has shown that exposure to naphthalene in the air at a workplace can lead to DNA strand breaks, which are often seen as a precursor to tumor formation (Marczynski et al. 2005).
3. There have been numerous reports of hemolytic anemia and cataracts following occupational exposure to naphthalene (ATSDR 1995).
4. Naphthalene in expired air has been studied as a biomarker of dermal and inhalational exposure to jet fuel, but the elimination in breath is fairly rapid, with a halftime of 19 to 25 minutes (Egeghy et al. 2003).
5. Occupational monitoring of naphthalene exposure usually involves the measurement of the urinary metabolites 1-naphthol and 2-naphthol (Preuss et al. 2003).
6. The EPA reference concentration is based on an inhalation study in mice in which hyperplasia and metaplasia in respiratory and olfactory epithelium, were observed in nearly all the animals at 30 ppm, which was the lowest dose tested (EPA 1998).
7. The NTP classification of naphthalene as reasonably anticipated to be carcinogenic to humans, and the IARC classification as Group 2B, possibly carcinogenic to humans, was based on an inhalation bioassay in rats and mice (IARC 2002).

**Date Last Revised:** 12/11/2012

#### Literature Basis

ACGIH: Documentation of the Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) - Naphthalene. 2001.  
 ATSDR: [Toxicological Profile for Naphthalene, 1-Methylnaphthalene and 2-Methylnaphthalene](#). 2005.  
 Egeghy, P.P., Hauf-Cabalo, L., Gibson, R. and Rappaport, S.M.: Benzene and naphthalene in air and breath as indicators of exposure to jet fuel. *Occup. Environ. Med.* 60(12): 969-976, 2003.  
[EPA IRIS Naphthalene \(1998\)](#)  
 IARC Monographs on Evaluation of Carcinogenic Risks to Humans, Volume 82, Naphthalene, 2002  
 Marczynski, B. et al.: Genotoxic risk assessment in white blood cells of occupationally exposed workers before and after alteration of the polycyclic aromatic hydrocarbon (PAH) profile in the production material: comparison with PAH air and urinary metabolite levels. *Int Arch Occup Environ Health* 78(2): 97-108, 2005.  
 NIOSH: *Occupational Health Guideline for Naphthalene*. September 1978.  
 NIOSH/IPC: International Chemical Safety Cards - [Naphthalene](#). April 21, 2005.  
 National Toxicology Program (NTP). Toxicology and carcinogenesis studies of naphthalene in B6C3F1 mice (inhalation studies). Technical Report Series No. 410. NIH Publication No. 92-3141. (1992).  
[NTP 12th Report on Carcinogens Naphthalene, 2011](#) [144 KB PDF, 3 pages].  
 Preuss, R., Angerer, J. and Drexler, H.: Naphthalene - an environmental and occupational toxicant. *Int. Arch. Occup. Environ. Health* 76 (8): 556-576, 2003.

#### Monitoring Methods used by OSHA

##### Laboratory Sampling/ Analytical Method:

**sampling media:** Chromosorb 106 Tube (100/50 mg sections, 60/80 mesh)  
**analytical solvent:** Carbon Disulfide  
**maximum volume:** 10 Liters  
**maximum flow rate:** 0.2 L/min (TWA)  
**maximum volume:** 3 Liters  
**maximum flow rate:** 0.2 L/min (STEL)  
**current analytical method:** Gas Chromatography; GC/FID  
**method reference:** OSHA Analytical Method ([OSHA 35](#))

**method classification:** Fully Validated

**note:** Submit as a separate sample.

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Telephone: 800-321-OSHA (6742) | TTY

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Naphthalene					
Synonyms & Trade Names Naphthalin, Tar camphor, White tar					
CAS No. 91-20-3		RTECS No. QJ0525000 (/niosh-rtecs/QJ8o2C8.html)		DOT ID & Guide 1334 133 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=133) (http://www.cdc.gov/Other/disclaimer.html) (crude or refined) 2304 133 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=133) (http://www.cdc.gov/Other/disclaimer.html) (molten)	
Formula C10H8		Conversion 1 ppm = 5.24 mg/m3		IDLH 250 ppm See: 91203 (/niosh/idlh/91203.html)	
Exposure Limits NIOSH REL : TWA 10 ppm (50 mg/m3) ST 15 ppm (75 mg/m3) OSHA PEL (nengapdxg.html) : TWA 10 ppm (50 mg/m3)			Measurement Methods NIOSH 1501 (/niosh/docs/2003-154/pdfs/1501.pdf) ; OSHA 35 (http://www.osha.gov/dts/sltc/methods/organic/org035/org035.html) (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description Colorless to brown solid with an odor of mothballs. [Note: Shipped as a molten solid.]					
MW: 128.2	BP: 424° F	MLT: 176°F	Sol: 0.003%	VP: 0.08 mmHg	IP: 8.12 eV
Sp.Gr: 1.15	Fl.P: 174° F	UEL: 5.9%	LEL: 0.9%		
Combustible Solid, but will take some effort to ignite.					
Incompatibilities & Reactivities Strong oxidizers, chromic anhydride					
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact					
Symptoms irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage					
Target Organs Eyes, skin, blood, liver, kidneys, central nervous system					
Personal Protection/Sanitation (See protection codes (protect.html))			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately		

**Skin:** Prevent skin contact  
**Eyes:** Prevent eye contact  
**Wash skin:** When contaminated  
**Remove:** When wet or contaminated  
**Change:** Daily

**Skin:** Molten flush immediately/solid-liquid soap wash promptly  
**Breathing:** Respiratory support  
**Swallow:** Medical attention immediately

#### Respirator Recommendations

##### NIOSH/OSHA

##### Up to 100 ppm:

(APF = 10) Any air-purifying half-mask respirator with organic vapor cartridge(s) in combination with an N95, R95, or P95 filter. The following filters may also be used: N99, R99, P99, N100, R100, P100.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.\*

(APF = 10) Any supplied-air respirator\*

##### Up to 250 ppm:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode\*

(APF = 50) Any air-purifying full-facepiece respirator equipped with organic vapor cartridge(s) in combination with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

(APF = 25) Any powered, air-purifying respirator with an organic vapor cartridge in combination with a high-efficiency particulate filter.\*

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

##### Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

##### Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nrp\)](#) for information on selection of N, R, or P filters.

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0667](#)

[\(/niosh/ipcsneng/neng0667.html\)](#) See MEDICAL TESTS: [0152 \(/niosh/docs/2005-110/nmed0152.html\)](#)

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Content source: [National Institute for Occupational Safety and Health \(NIOSH\)](#) Education and Information Division

Centers for Disease Control and Prevention 1600 Clifton Rd. Atlanta, GA 30333, USA  
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## Technology Transfer Network - Air Toxics Web Site

# Naphthalene

91-20-3

### Hazard Summary-Created in April 1992; Revised in January 2000

Naphthalene is used in the production of phthalic anhydride; it is also used in mothballs. Acute (short-term) exposure of humans to naphthalene by inhalation, ingestion, and dermal contact is associated with hemolytic anemia, damage to the liver, and neurological damage. Cataracts have also been reported in workers acutely exposed to naphthalene by inhalation and ingestion. Chronic (long-term) exposure of workers and rodents to naphthalene has been reported to cause cataracts and damage to the retina. Hemolytic anemia has been reported in infants born to mothers who "sniffed" and ingested naphthalene (as mothballs) during pregnancy. Available data are inadequate to establish a causal relationship between exposure to naphthalene and cancer in humans. EPA has classified naphthalene as a Group C, possible human carcinogen.

Please Note: The main sources of information for this fact sheet are the EPA's [Toxicological Review of Naphthalene](#) and the Agency for Toxic Substances and Disease Registry's (ATSDR's) [Toxicological Profile for Naphthalene](#).

### Uses

The primary use for naphthalene is in the production of phthalic anhydride. However, *o*-xylene is replacing naphthalene as the preferred raw material for phthalic anhydride production. (1)

Other uses of naphthalene include carbamate insecticides, surface active agents and resins, as a dye intermediate, as a synthetic tanning agent, as a moth repellent, and in miscellaneous organic chemicals. (1,2)

### Sources and Potential Exposure

Individuals may be exposed to naphthalene through the use of mothballs. (1)

Workers may be occupationally exposed to naphthalene during its manufacture and use, especially in coal-tar production, wood preserving, tanning, or ink and dye production. (1)

Naphthalene is released to the air from the burning of coal and oil and from the use of mothballs. Coal tar production, wood preserving, and other industries release small amounts. (1)

Typical air concentrations of naphthalene in cities are about 0.18 parts per billion (ppb). (1)

Naphthalene has also been detected in tobacco smoke. (1)

### Assessing Personal Exposure

Naphthalene or its breakdown products can be measured in fat, urine, and feces. These tests cannot be used to find out how much exposure occurred and require special equipment not routinely available in a doctor's office. (1)

### Health Hazard Information

#### Acute Effects:

Acute exposure of humans to naphthalene by inhalation, ingestion, and dermal contact is associated with hemolytic anemia, damage to the liver, and, in infants, neurological damage. Symptoms of acute exposure include headache, nausea, vomiting, diarrhea, malaise, confusion, anemia, jaundice, convulsions, and coma. (1,2,6,7)

Cataracts have been reported in humans acutely exposed to naphthalene by inhalation and ingestion. Cataracts have also been reported in animals following acute oral exposure. (6,7,9)

Tests involving acute exposure of rats, mice, rabbits, and guinea pigs have demonstrated naphthalene to have moderate to high acute toxicity from ingestion and low to moderate acute toxicity from dermal exposure. (3)

#### Chronic Effects (Noncancer):

Chronic exposure of workers to naphthalene has been reported to cause cataracts and retinal hemorrhage. (2,4,5,6,7)

Chronic inflammation of the lung, chronic nasal inflammation, hyperplasia of the respiratory epithelium in the nose, and metaplasia of the olfactory epithelium were reported in mice chronically exposed to naphthalene via inhalation. (1,6,7)

Rats, rabbits, and mice chronically exposed to naphthalene via ingestion have developed cataracts and degeneration of the retina. (2,5,6,7)

Diarrhea, lethargy, hunched posture, rough coats, decreased body weight, and lesions in the kidneys and thymus were observed in rats and mice chronically exposed via gavage (experimentally placing the chemical in the stomach). (2,6,7)

EPA has calculated a Reference Concentration (RfC) of 0.003 milligrams per cubic meter (mg/m<sup>3</sup>) for naphthalene based on nasal effects in mice. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human

population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (6,7)

EPA has medium confidence in the RfC based on: 1) medium confidence in the principal study because adequate numbers of animals were used, severity of nasal effects increased at higher exposure concentrations, high mortality, and hematological evaluation not conducted beyond 14 days; and 2) low to medium confidence in the database because there are no chronic or subchronic inhalation studies in other animal species and there are no reproductive or developmental inhalation studies. (6,7)

The Reference Dose (RfD) for naphthalene is 0.02 milligrams per kilogram body weight per day (mg/kg/d) based on decreased body weight in male rats. (6,7)

EPA has low confidence in the RfD based on: 1) high confidence in the principal study because adequate numbers of animals were included and experimental protocols were adequately designed, conducted, and reported; and 2) low confidence in the database because of the lack of adequate chronic oral data, dose-response data for hemolytic anemia, and two-generation reproductive toxicological studies. (6,7)

#### **Reproductive/Developmental Effects:**

Hemolytic anemia has been reported in infants born to mothers who "sniffed" and ingested naphthalene (as mothballs) during pregnancy.

The mothers themselves were anemic, but to a lesser extent than the infants. (5,6,7)

Signs of maternal toxicity (e.g., decreased body weight and lethargy) but no fetal effects were reported in rats and rabbits exposed to naphthalene via gavage. (6,7)

Maternal toxicity (increased mortality and reduced weight gain) and fetotoxicity (reduced number of live pups per litter) were observed in mice exposed via gavage. (2,6,7)

#### **Cancer Risk:**

Workers occupationally exposed to vapors of naphthalene and coal tar developed laryngeal carcinomas or neoplasms of the pylorus and cecum. However, this study is inadequate because there were no controls, exposure levels were not determined, and subjects were exposed to complex mixtures containing other demonstrated carcinogens. (2,5,6,7)

Di-, tri-, and tetramethyl naphthalene contaminants of coal tar were found to be carcinogenic when applied to the skin of mice, but naphthalene alone was not. (2,5)

An increased number of alveolar/bronchiolar adenomas and carcinomas were reported in female mice exposed by inhalation. (1,6,7)

No carcinogenic responses were reported in rats exposed to naphthalene in their diet and by injection. (2,5,6)

EPA has classified naphthalene as a Group C, possible human carcinogen. (6,7)

### **Physical Properties**

The chemical formula for naphthalene is  $C_{10}H_8$ , and its molecular weight is 128.19 g/mol. (1)

Naphthalene occurs as a white solid or powder that is insoluble in water. (1,8)

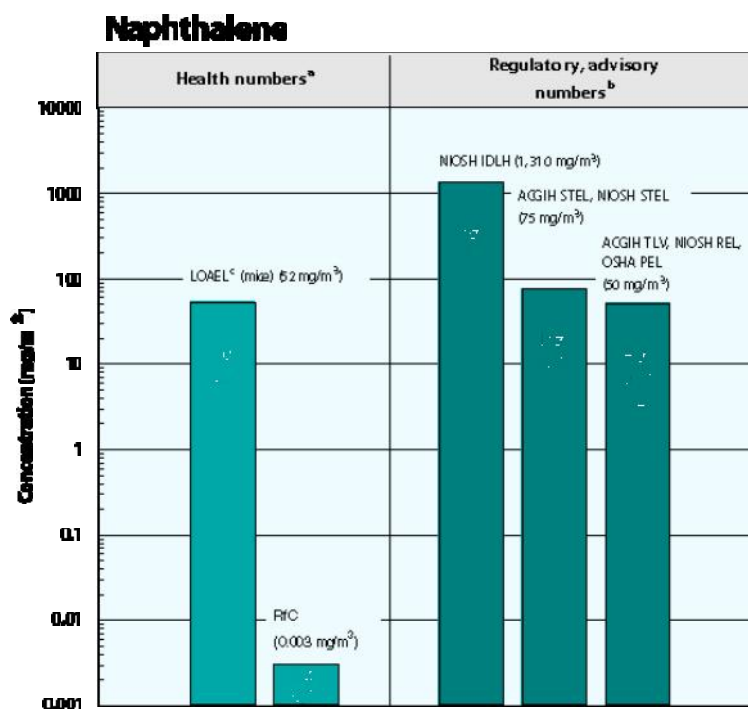
Naphthalene has a strong, mothball odor, with an odor threshold of 0.44 mg/m<sup>3</sup> (0.084 parts per million, ppm). (1,9)

The vapor pressure for naphthalene is 0.087 mm Hg at 25 °C, and its log octanol/water partition coefficient (log  $K_{ow}$ ) is 3.29. (1)

#### **Conversion Factors:**

To convert concentrations in air (at 25 °C) from ppm to mg/m<sup>3</sup>:  $mg/m^3 = (ppm) \times (\text{molecular weight of the compound}) / (24.45)$ . For naphthalene: 1 ppm = 5.24 mg/m<sup>3</sup>.

### **Health Data from Inhalation Exposure**



**ACGIH TLV**--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

**ACGIH STEL**--American Conference of Governmental and Industrial Hygienists' threshold limit value short-term exposure limit; a 15-minute TWA exposure which should not be exceeded at any time during a workday.

**LOAEL**--Lowest observed adverse effect level.

**NIOSH REL**--National Institute of Occupational Safety and Health's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

**NIOSH IDLH** -- NIOSH's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

**NIOSH STEL**--NIOSH's recommended short-term exposure limit; a 15-minute TWA exposure which should not be exceeded at any time during a workday.

**OSHA PEL**--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

<sup>a</sup> Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

<sup>b</sup> Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

<sup>c</sup> This LOAEL is from the critical study used as the basis for the EPA RfC.

## References

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2. U.S. Environmental Protection Agency. *Health and Environmental Effects Profile for Naphthalene*. EPA/600/x-86/241. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1986.
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11. National Institute for Occupational Safety and Health (NIOSH). *Pocket Guide to Chemical Hazards*. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 1997.
12. Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Standards, Toxic and Hazardous Substances. *Code of Federal Regulations* 29 CFR 1910.1000. 1998.

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Last updated on Friday, October 18, 2013

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## Trichloroethylene

### General Description

**Synonyms:** Ethylene trichloride; TCE; Trichloroethene; Tridene**OSHA IMIS Code Number:** 2490**Chemical Abstracts Service (CAS) Registry Number:** 79-01-6**NI OSH Registry of Toxic Effects of Chemical Substances (RTECS) Identification Number:**  
[KX4550000](#)**Department of Transportation Regulation Number (49 CFR 172.101) and Guide:** 1710 [160](#)**NI OSH Pocket Guide to Chemical Hazards, [Trichloroethylene](#):** chemical description, physical properties, potentially hazardous incompatibilities, and more

### Exposure Limits

**OSHA Permissible Exposure Limit (PEL):****General Industry:** [29 CFR 1910.1000 Z-2 Table](#) -- 100 ppm TWA; Also, exposures shall not exceed 200 ppm (ceiling) with the following exception: exposures may exceed 200 ppm, but not more than 300 ppm (peak), for a single time period up to 5 minutes in any 2 hours.**Construction Industry:** [29 CFR 1926.55 Appendix A](#) -- 100 ppm, 535 mg/m<sup>3</sup> TWA**Maritime:** [29 CFR 1915.1000 Table Z-Shipyards](#) -- 100 ppm, 535 mg/m<sup>3</sup> TWA**American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV):** 10 ppm TWA; 25 ppm STEL; Suspected Human Carcinogen (A2); BEI**National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL):** [Appendix A](#) - NIOSH Potential Occupational Carcinogens; [Appendix C](#) - Supplementary Exposure Limits - 2 ppm 1-hour Ceiling as an anesthetic agent and 25 ppm 10-hour TWA all other exposures

### Health Factors

**Carcinogenic Classification:****International Agency for Research on Cancer (IARC):** [Group 2A, probably carcinogenic to humans](#) [5 MB PDF, 84 pages]**NI OSH Immediately Dangerous To Life or Health Concentration (IDLH):** [1,000 ppm](#)**Potential Symptoms:** Irritation of eyes, skin; headache; visual disturbance; lassitude (weakness, exhaustion), dizziness; tremor; drowsiness, nausea; vomiting; dermatitis; cardiac arrhythmias; paresthesia; liver injury; potential male reproductive toxin; [potential occupational carcinogen]**Health Effects:** Narcosis (HE8); Cumulative systemic toxicity (HE3) Mutagen/Suspect carcinogen (HE2); Suspect teratogen (HE5)**Affected Organs:** Kidneys, liver, eyes, skin, CNS, cardiovascular system**Notes:**

1. Trichloroethylene (TCE) was formerly used as an inhalational anesthetic for surgery.
2. TCE is metabolized mainly by cytochrome P-450 2E1 to TCE oxide (which forms adducts with lysine residues in proteins) and chloral (active as a sedative-hypnotic drug), both of which are further metabolized. This CYP2E1 is inducible, as well as inhibited, by ethanol.

**Chemical Sampling Information (CSI)****Search** (use word(s)/phrase) **Table of Contents****By Name**[A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#)  
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[OSHA Occupational Chemical Database](#)

3. Chloral may also be transformed in the body into a dopaminergic neurotoxin.
4. In addition to dermatitis from a skin defatting action, a severe generalized dermatitis with hepatitis can occur after TCE exposure.
5. One case of parkinsonism after occupational exposure to TCE was reported.
6. Toxicity to epididymal epithelium found in mice that inhaled TCE may be due to toxic metabolites formed via CYP2E1, an enzyme that also occurs in human epididymal epithelium and testicular Leydig cells.
7. The amounts of TCE residue allowable in decaffeinated coffee and spice oleoresins are regulated by the FDA ([21 CFR 173.290](#)).

**Literature Basis:**

NIOSH Pocket Guide to Chemical Hazards: [Trichloroethylene](#).  
International Chemical Safety Cards (WHO/IPC/IL0): [Trichloroethylene](#).  
EPA Air Toxics Website: [Trichloroethylene](#). U.S. Environmental Protection Agency Technology Transfer Network.  
Bringmann, G, God, R, Fahr, S, Feineis, D., Fornadi, K. and Fornadi, F.: Identification of the dopaminergic neurotoxin 1-trichloromethyl-1,2,3,4-tetrahydro-beta-carboline in human blood after intake of the hypnotic chloral hydrate. *Anal. Biochem.* 270(1): 167-175, 1999.  
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**Date Last Revised:** 07/07/2004

**Monitoring Methods used by OSHA****Laboratory Sampling/ Analytical Method:**

**sampling media:** Charcoal Tube (100/50 mg sections, 20/40 mesh)

**analytical solvent:** Carbon Disulfide

**maximum volume:** 12 Liters

**maximum flow rate:** 0.05 L/min

**minimum time:** >5 Minutes

**maximum flow rate:** 0.05 L/min (Ceiling)

**minimum time:** > 1 Minute

**maximum flow rate:** 0.05 L/min (Peak)

**current analytical method:** Gas Chromatography; GC/FID

**method reference:** OSHA Analytical Method ([OSHA 1001](#))

**method classification:** Fully Validated

**sampling media:** Diffusive Sampler (SKC 575-002 Passive Sampler)

**analytical solvent:** Carbon Disulfide

**sampling time:** < or 240 Minutes (TWA); > 5 Minutes (Ceiling); > 5 Minutes (Peak)

**current analytical method:** Gas Chromatography; GC/FID

**method reference:** OSHA Analytical Method ([OSHA 1001](#))

**method classification:** Fully Validated

**note:** Persons using diffusive samplers to monitor workplace air must ensure that the sampling devices are properly closed before transporting such devices to the laboratory for analysis. The device will continue to sample until properly closed. Diffusive sampler accessories used for analysis of samplers must be included with transported samples. Persons using such devices must provide sampling-site station barometric pressure and temperature to the analytical laboratory to improve accuracy of sampling results.

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# Ethylene, trichloro -

**RTECS #: KX4550000**

**CAS #: 79-01-6**

<b>UPDATE: May 2009</b>	<b>MW: 131.38</b>	<b>MF: C<sub>2</sub>HCl<sub>3</sub></b>
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## NOTE:

**TOXICITY DATA HAVE NOT BEEN EVALUATED. OMISSION OF A SUBSTANCE OR NOTATION DOES NOT IMPLY ANY RELIEF FROM REGULATORY RESPONSIBILITY.**

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## SYNONYMS:

- |  |                                       |
|--|---------------------------------------|
| 1. 1,1,2 - Trichloroethylene           | 37. Threthylene                       |
| 2. 1,1 - Dichloro - 2 - chloroethylene | 38. Trethylene                        |
| 3. 1,2,2 - Trichloroethylene           | 39. Tri                               |
| 4. 1 - Chloro - 2,2 - dichloroethylene | 40. Tri - clene                       |
| 5. Acetylene trichloride               | 41. Tri - plus                        |
| 6. Algylen                             | 42. Tri - plus M                      |
| 7. Anamenth                            | 43. Triad                             |
| 8. Benzinol                            | 44. Trial                             |
| 9. Blacosolv                           | 45. Triasol                           |
| 10. Blancosolv                         | 46. Trichlooretheen (Dutch)           |
| 11. Cecolene                           | 47. Trichloorethyleen, tri (Dutch)    |
| 12. Chlorilen                          | 48. Trichloroethen (German)           |
| 13. Chlorylen                          | 49. Trichloroethylen, tri (German)    |
| 14. Circosolv                          | 50. Trichloran                        |
| 15. Crawhaspol                         | 51. Trichloren                        |
| 16. Densinfluat                        | 52. Trichloroethylene, tri (French)   |
| 17. Dow - tri                          | 53. Trichloroethene                   |
| 18. Dukeron                            | 54. Trichloroethylene                 |
| 19. Ethinyl trichloride                | 55. Trichloroethylene<br>(ACGIH:OSHA) |
| 20. Ethylene trichloride               | 56. Trichloroethylene (IUPAC)         |
| 21. Fleck - flip                       | 57. Triclorotene (Italian)            |
| 22. Flock FLIP                         | 58. Tricloroetilene (Italian)         |
| 23. Fluante                            |                                       |

24. Germalgene	59. Trielene
25. Lanadin	60. Trielin
26. Lethurin	61. Trielina (Italian)
27. NCI - C04546	62. Trieline
28. Narcogen	63. Trilen
29. Narkosoid	64. Trilene
30. Nialk	65. Trilene TE - 141
31. Perm - A - chlor	66. Triline
32. Petzinol	67. Trimar
33. Philex	68. Triol
34. RCRA waste number U228	69. Vestrol
35. TCE	70. Vitran
36. Threthylen	71. Westrosol

### SKIN AND EYE IRRITATION DATA AND REFERENCES:

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE
eye rabbit	20 mg/24 hour	moderate	<a href="#">85JCAE</a> -,106,1986
skin rabbit	2 mg/24 hour	severe	<a href="#">85JCAE</a> -,106,1986

### MUTATION DATA AND REFERENCES:

SYSTEM TEST	ROUTE/ ORGANISM/ TISSUE	DOSE	REFERENCE
cytogenetic analysis	skin mouse	7 gm/kg	<a href="#">EMMUEG</a> 37,185,2001
cytogenetic analysis	multiple other fish	3 gm/L	<a href="#">MUREAV</a> 399,125,1998

DNA adduct	mammal (species unspecified) lymphocyte	1 mmol/L	<a href="#">TOLED5</a> 11,243,1982
DNA damage	human kidney	1 mmol/L/20 hour	<a href="#">TXCYAC</a> 204,187,2004
DNA damage	intraperitoneal mouse	6 mmol/kg	<a href="#">TOLED5</a> 31,31,1986
DNA damage	mouse liver	100 µmol/L	<a href="#">CNREA8</a> 43,1145,1983
DNA damage	rat liver	100 µmol/L	<a href="#">CNREA8</a> 43,1145,1983
DNA damage	rat kidney	1 mmol/L/20 hour	<a href="#">TXCYAC</a> 204,187,2004
DNA damage	oral rat	3,591 mg/kg	<a href="#">TXCYAC</a> 204,187,2004
DNA damage	Saccharomyces cerevisiae	22 mmol/L	<a href="#">MUREAV</a> 206,209,1988
DNA inhibition	human lymphocyte	5 mL/L	<a href="#">CALEDQ</a> 13,213,1981
DNA repair	intraperitoneal mouse	100 mg/kg	<a href="#">EVHPAZ</a> 109,71,2001
unscheduled DNA synthesis	human lung	100 mg/L	<a href="#">NTIS**</a> PB82-185075
unscheduled DNA synthesis	oral mouse	2,500 mg/L	<a href="#">NTIS**</a> AD-A080-636
unscheduled DNA synthesis	mouse bone marrow	1 mmol/L	<a href="#">NTIS**</a> AD-A080-636
unscheduled DNA synthesis	rat liver	2,800 µmol/L	<a href="#">CRNGDP</a> 5,1629,1984
unscheduled DNA synthesis	oral rat	16,500 mg/kg/3 week- intermittent	<a href="#">TXAPA9</a> 62,137,1982
host-mediated assay	mouse Saccharomyces cerevisiae	400 mg/kg	<a href="#">JEPTDQ</a> 1 (4),411,1978
mutation in microorganisms	Aspergillus nidulans	2,500 ppm (-enzymatic activation step)	<a href="#">MUREAV</a> 155,105,1985

mutation in microorganisms	Escherichia coli	3,300 µmol/L (+enzymatic activation step)	<a href="#">BCPCA6</a> 24,2013,1975
mutation in microorganisms	mouse lymphocyte	146 mg/L (+enzymatic activation step)	<a href="#">SCIEAS</a> 236,933,1987
mutation in microorganisms	Salmonella typhimurium	10 µg/plate (+/- enzymatic activation step)	<a href="#">TECSDY</a> 15,101,1987
mutation in microorganisms	Salmonella typhimurium	5,000 mg/L/2 hour (-enzymatic activation step)	<a href="#">EMMUEG</a> 44,329,2004
mutation in microorganisms	Saccharomyces cerevisiae	40 mmol/L (+enzymatic activation step)	<a href="#">JEPTDQ 1</a> (4),411,1978
micronucleus test	human kidney	1 mmol/L/48 hour	<a href="#">TXCYAC</a> 204,187,2004
micronucleus test	intraperitoneal mouse	1 gm/kg	<a href="#">MUREAV</a> 413,151,1998
micronucleus test	multiple other fish	3 gm/L	<a href="#">MUREAV</a> 399,125,1998
micronucleus test	inhalation rat	5 ppm/6 hour-continuous	<a href="#">MUREAV</a> 322,87,1994
micronucleus test	oral rat	4 mmol/kg	<a href="#">MUREAV</a> 413,1,1998
micronucleus test	rat kidney	1 mmol/L/48 hour	<a href="#">TXCYAC</a> 204,187,2004
micronucleus test	oral rat	3,590 mg/kg	<a href="#">TXCYAC</a> 204,187,2004
gene conversion and mitotic recombination	Saccharomyces cerevisiae	20 mmol/L	<a href="#">JEPTDQ 1</a> (4),411,1978
morphological transform	hamster embryo	5 mg/L	<a href="#">CRNGDP</a> 4,291,1983
morphological transform	mouse embryo	20 mg/L	<a href="#">CALEDQ</a> 28,85,1985
	rat embryo	1,100 µmol/L	

morphological transform			<a href="#">ITCSAF</a> 14,290,1978
other mutation test systems	hamster fibroblast	1 pph	<a href="#">ANESAV</a> 43,21,1975
other mutation test systems	oral mouse	600 mg/kg	<a href="#">MUREAV</a> 343,157,1995
phage inhibition capacity	Escherichia coli	18 µg/well	<a href="#">MUREAV</a> 260,349,1991
sister chromatid exchange	hamster ovary	401 mg/L	<a href="#">EMMUEG</a> 10 (Suppl 10),1,1987
sister chromatid exchange	human lymphocyte	178 mg/L	<a href="#">AGTQAH</a> 24,105,1981
sex chromosome loss and nondisjunction	Aspergillus nidulans	17,500 ppm	<a href="#">MUREAV</a> 155,105,1985
sex chromosome loss and nondisjunction	hamster lung	1,150 µmol/L	<a href="#">MUREAV</a> 182,135,1987
sex chromosome loss and nondisjunction	Saccharomyces cerevisiae	11 mmol/L	<a href="#">MUREAV</a> 206,209,1988
specific locus test	intraperitoneal mouse	140 mg/kg	<a href="#">ARTODN</a> 38,87,1977
sperm morphology	inhalation mouse	100 ppm	<a href="#">NTIS**</a> PB82-185075

## REPRODUCTIVE EFFECTS DATA AND REFERENCES:

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE
inhalation mouse	lowest published toxic concentration: 100 ppm/7 hour (5 day male)	Reproductive: Paternal effects: Spermatogenesis (including genetic material, sperm morphology, motility, and count)	<a href="#">NTIS**</a> PB82-185075

inhalation mouse	lowest published toxic concentration: 150 ppm/24 hour (4 week male/4 week prior to copulation-3 week pregnant)	Reproductive: Specific developmental abnormalities: Central nervous system	<a href="#">TOLED5</a> 23,223,1984
inhalation rat	lowest published toxic concentration: 1,800 ppm/24 hour (1-20 day pregnant)	Reproductive: Specific developmental abnormalities: Musculoskeletal system  Reproductive: Other developmental abnormalities	<a href="#">APTOD9</a> 19,A22,1980
inhalation rat	lowest published toxic concentration: 100 ppm/4 hour (6-22 day pregnant)	Reproductive: Effects on fertility: Post-implantation mortality (e.g., dead and/or resorbed implants per total number of implants)  Reproductive: Effects on embryo or fetus: Fetotoxicity (except death, e.g., stunted fetus)	<a href="#">JPHYA7</a> 276,24P,1978
inhalation rat	lowest published toxic concentration: 1,800 ppm/6 hour (1-20 day pregnant)	Reproductive: Specific developmental abnormalities: Urogenital system	<a href="#">TXCYAC</a> 14,153,1979
inhalation rat	lowest published toxic concentration: 100 ppm/4 hour (8-21 day pregnant)	Reproductive: Specific developmental abnormalities: Musculoskeletal system	<a href="#">BJANAD</a> 54,337,1982
oral mouse	lowest published toxic dose: 176 gm/kg (15 week male/15 week prior to copulation-3 week after birth)	Reproductive: Effects on fertility: Post-implantation mortality (e.g., dead and/or resorbed implants per	<a href="#">NTIS**</a> #PB86173150

		total number of implants)	
oral mouse	lowest published toxic dose: 24.5 gm/kg (7 day male/7 day prior to copulation/21 day pregnant)	Reproductive: Effects on newborn: Growth statistics (e.g., reduced weight gain)	<a href="#">NTIS**</a> #PB86173150
oral mouse	lowest published toxic dose: 700 mg/kg (multigenerations)	Reproductive: Specific developmental abnormalities: Hepatobiliary system  Reproductive: Specific developmental abnormalities: Urogenital system	<a href="#">NTIS**</a> #PB86173150
oral mouse	lowest published toxic dose: 8.4 mg/kg (0 day pregnant - 21 day after birth)	Reproductive: Specific developmental abnormalities: Immune and reticuloendothelial system	<a href="#">TOXID9</a> 72 (Suppl 1),375,2003
oral mouse	lowest published toxic dose: 84 mg/kg (0 day pregnant - 21 day after birth)	Reproductive: Other developmental abnormalities	<a href="#">TOXID9</a> 72 (Suppl 1),375,2003
oral mouse	lowest published toxic dose: 8.4 mg/kg (multigeneration)	Reproductive: Specific developmental abnormalities: Immune and reticuloendothelial system	<a href="#">TOXID9</a> 72 (Suppl 1),375,2003
oral rat	lowest published toxic dose: 2,688 mg/kg (1-22 day pregnant/21 day after birth)	Reproductive: Effects on newborn: Behavioral	<a href="#">TOXID9</a> 4,179,1984
oral rat	lowest published toxic dose: 36 gm/kg (15 day prior to copulation/1-21 day pregnant)	Reproductive: Effects on newborn: Weaning or lactation index (e.g., # alive at weaning per # alive at day 4)	<a href="#">TXCYAC</a> 32,229,1984

oral rat	lowest published toxic dose: 1,140 mg/kg (14 day prior to copulation-21 day after birth)	Reproductive: Specific developmental abnormalities: Central nervous system	<a href="#">BRREAP</a> 488,403,1989
oral rat	lowest published toxic dose: 19 gm/kg (15 week male/15 week prior to copulation-3 week after birth)	Reproductive: Effects on newborn: Growth statistics (e.g., reduced weight gain)	<a href="#">NTIS**</a> #PB86190782
oral rat	lowest published toxic dose: 5.5 gm/kg (7 day male/7 day prior to copulation/21 day pregnant)	Reproductive: Effects on fertility: Litter size (e.g., # fetuses per litter; measured before birth)	<a href="#">NTIS**</a> #PB86190782
oral rat	lowest published toxic dose: 76 mg/kg (multigenerations)	Reproductive: Specific developmental abnormalities: Hepatobiliary system  Reproductive: Specific developmental abnormalities: Urogenital system  Reproductive: Effects on newborn: Growth statistics (e.g., reduced weight gain)	<a href="#">NTIS**</a> #PB86190782
oral rat	lowest published toxic dose: 156 mg/kg (multigenerations)	Reproductive: Specific developmental abnormalities: Urogenital system	<a href="#">NTIS**</a> #PB86190782
oral rat	lowest published toxic dose: 10,115 mg/kg (7 day male/7 day prior to copulation/21 day pregnant)	Reproductive: Effects on fertility: Other measures of fertility	<a href="#">NTIS**</a> #PB86190782
oral rat	lowest published toxic dose: 1,010 mg/kg (6-15 day pregnant)	Reproductive: Specific developmental abnormalities: Eye, ear	<a href="#">EVHPAZ</a> 108,323,2000

oral rat	lowest published toxic dose: 60.5 mg/kg (1-11 day pregnant)	Reproductive: Specific developmental abnormalities: Homeostasis	<a href="#">BDERE*</a> 67,488,2003
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## TUMORIGENIC DATA AND REFERENCES:

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE
inhalation hamster	lowest published toxic concentration: 100 ppm/6 hour/77 week-intermittent	Tumorigenic: Equivocal tumorigenic agent by RTECS criteria  Blood: Lymphoma including Hodgkin's disease  Liver: Tumors	<a href="#">ARTODN</a> 43,237,1980
inhalation mouse	lowest published toxic concentration: 150 ppm/7 hour/2 year-intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Vascular: Tumors  Lung, Thorax, or Respiration: Tumors	<a href="#">INHEAO</a> 21,243,1983
inhalation mouse	toxic concentration (other than lowest) : 500 ppm/6 hour/77 week-intermittent	Tumorigenic: Equivocal tumorigenic agent by RTECS criteria  Blood: Lymphoma including Hodgkin's disease	<a href="#">ARTODN</a> 43,237,1980

inhalation mouse	toxic concentration (other than lowest) : 150 ppm/7 hour/2 year- intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Lung, Thorax, or Respiration: Tumors  Skin and Appendages: Tumors	<a href="#">INHEAO</a> 21,243,1983
inhalation rat	lowest published toxic concentration: 150 ppm/7 hour/2 year- intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Lung, Thorax, or Respiration: Tumors  Skin and Appendages: Tumors	<a href="#">INHEAO</a> 21,243,1983
oral mouse	lowest published toxic dose: 455 gm/kg/78 week- intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Liver: Tumors	<a href="#">NCITR*</a> NCI-TR-2,1976
oral mouse	toxic dose : 912 gm/kg/78 week- intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Liver: Tumors	<a href="#">NCITR*</a> NCI-TR-2,1976
oral mouse	toxic dose : 515 gm/kg/2 year- intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Liver: Tumors  Blood: Tumors	<a href="#">NTPTR*</a> NTP-TR-243,1990
oral mouse	lowest published toxic dose: 515,000 mg/kg/103 week- intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Liver: Tumors	<a href="#">NTIS**</a> PB91-111815

oral mouse	lowest published toxic dose: 553 gm/kg/79 week- intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Liver: Tumors  Tumorigenic: Increased incidence of tumors in susceptible strains	<a href="#">TXAPA9</a> 182,55,2002
oral rat	lowest published toxic dose: 515,000 mg/kg/103 week- intermittent	Tumorigenic: Equivocal tumorigenic agent by RTECS criteria  Kidney, Ureter, and Bladder: Kidney tumors	<a href="#">NTIS**</a> PB91-111815
unreported route mouse	lowest published toxic dose: 456 gm/kg/28 week- intermittent	Tumorigenic: Equivocal tumorigenic agent by RTECS criteria  Liver: Tumors	<a href="#">VCVGH*</a> -,446,1990
unreported route mouse	lowest published toxic dose: 912 gm/kg/78 week- intermittent	Tumorigenic: Equivocal tumorigenic agent by RTECS criteria  Liver: Tumors	<a href="#">VCVGH*</a> -,446,1990

### ACUTE TOXICITY DATA AND REFERENCES:

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE

inhalation cat	lowest published lethal concentration: 32,500 mg/m <sup>3</sup> /2 hour	Peripheral Nerve and Sensation: Spastic paralysis with/without sensory change  Behavioral: General anesthetic  Behavioral: Change in motor activity (specific assay)	<a href="#">AHBAAM</a> 116,131,1936
inhalation cat	lowest published lethal concentration: 32,500 mg/m <sup>3</sup> /2 hour	N/R	<a href="#">VCVGH*</a> -,441,1990
inhalation cat	lowest published toxic concentration: 45,000 mg/m <sup>3</sup> /5 hour	Behavioral: General anesthetic	<a href="#">VCVGH*</a> -,442,1990
inhalation dog	lowest published toxic concentration: 90,000 mg/m <sup>3</sup> /2 hour	Behavioral: General anesthetic	<a href="#">VCVGH*</a> -,442,1990
inhalation guinea pig	lowest published lethal concentration: 37,200 ppm/40 minute	N/R	<a href="#">HBTXAC</a> 5,76,1959
inhalation human	lowest published toxic concentration: 6,900 mg/m <sup>3</sup> /10 minute	Behavioral: Somnolence (general depressed activity)  Behavioral: Hallucinations, distorted perceptions	<a href="#">AHBAAM</a> 116,131,1936
inhalation human	lowest published toxic concentration:	Behavioral: Hallucinations, distorted perceptions	<a href="#">AIHAAP</a> 23,167,1962

	160 ppm/83 minute		
inhalation human	lowest published toxic concentration: 812 mg/kg	Behavioral: Somnolence (general depressed activity)  Gastrointestinal: Other changes  Liver: Jaundice, other or unclassified	<a href="#">BMJOAE</a> 2,689,1945
inhalation human	lowest published toxic concentration: 500 ppm/16.1 year - intermittent	Kidney, Ureter, and Bladder: Changes in both tubules and glomeruli  Kidney, Ureter, and Bladder: Proteinuria  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Other transferases	<a href="#">ARTODN</a> 73,246,1999
inhalation human	lowest published toxic concentration: 110 ppm/8 hour	Behavioral: Change in psychophysiological tests	<a href="#">EVHPAZ</a> 108,323,2000
inhalation human	lowest published toxic concentration: 200 ppm/90 minute	Behavioral: Change in psychophysiological tests	<a href="#">AIHAAP</a> 28,43,1967
inhalation human	lowest published toxic concentration: 1.95 ppm/4 hour	Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Phosphatases	<a href="#">VCVGH*</a> -,443,1990
inhalation human	lowest published toxic concentration: 500 ppm	Behavioral: Somnolence (general depressed activity)	<a href="#">VCVGH*</a> -,443,1990
inhalation man	lowest published toxic	Eye: Other eye effects	<a href="#">BJIMAG</a> 28,293,1971

	<b>concentration: 110 ppm/8 hour</b>	<b>Behavioral: Hallucinations, distorted perceptions</b>	
<b>inhalation man</b>	<b>lowest published lethal concentration: 2,900 ppm</b>	<b>N/R</b>	<b><a href="#">NZMJAX</a> 50,119,1951</b>
<b>inhalation mouse</b>	<b>lethal concentration (50 percent kill): 8,450 ppm/4 hour</b>	<b>N/R</b>	<b><a href="#">APTOA6</a> 9,303,1953</b>
<b>inhalation mouse</b>	<b>lowest published toxic concentration: 450 ppm/6 hour</b>	<b>Lung, Thorax, or Respiration: Other changes</b>	<b><a href="#">EVHPAZ</a> 108,261,2000</b>
<b>inhalation mouse</b>	<b>lowest published toxic concentration: 10,000 ppm/4 hour</b>	<b>Lung, Thorax, or Respiration: Other changes</b>  <b>Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Cytochrome oxidases (including oxidative phosphorylation)</b>  <b>Biochemical: Effect on specific coenzyme: NAD, NADP</b>	<b><a href="#">EVHPAZ</a> 108,261,2000</b>
<b>inhalation mouse</b>	<b>lethal concentration (50 percent kill): 220,000 mg/m<sup>3</sup>/20 minute</b>	<b>N/R</b>	<b><a href="#">VCVGH*</a> -,441,1990</b>
<b>inhalation mouse</b>	<b>lethal concentration (50 percent kill): 262,000 mg/m<sup>3</sup>/30 minute</b>	<b>N/R</b>	<b><a href="#">VCVGH*</a> -,441,1990</b>
<b>inhalation mouse</b>	<b>lowest published lethal</b>	<b>N/R</b>	<b><a href="#">VCVGH*</a> -,441,1990</b>

	concentration: 16,000 mg/m <sup>3</sup> /2 hour		
inhalation mouse	lethal concentration (50 percent kill): 40,000 mg/m <sup>3</sup> /4 hour	N/R	<a href="#">VCVGH*</a> -,441,1990
inhalation mouse	lowest published toxic concentration: 25,000 mg/m <sup>3</sup> /2 hour	Behavioral: General anesthetic	<a href="#">VCVGH*</a> -,442,1990
inhalation rat	lowest published lethal concentration: 4,800 ppm/4 hour	N/R	<a href="#">AMIHBC</a> 4,469,1951
inhalation rat	lowest published toxic concentration: 2,000 ppm/70 minute	Behavioral: Alteration of operant conditioning	<a href="#">NETEEC</a> 22,221,2000
inhalation rat	lowest published toxic concentration: 4,000 ppm/1 hour	Brain and Coverings: Recordings from specific areas of CNS	<a href="#">EVHPAZ</a> 108,317,2000
inhalation rat	lowest published toxic concentration: 6,000 ppm/6 hour	Ear: Change in acuity  Ear: Change in cochlear structure or function	<a href="#">EVHPAZ</a> 108,317,2000
inhalation rat	lowest published toxic concentration: 1,000 ppm/4 hour	Brain and Coverings: Recordings from specific areas of CNS	<a href="#">EVHPAZ</a> 108,317,2000
inhalation rat	lowest published toxic concentration: 2,000 ppm/2 hour	Brain and Coverings: Recordings from specific areas of CNS	<a href="#">EVHPAZ</a> 108,317,2000

inhalation rat	lowest published toxic concentration: 3,000 ppm/80 minute	Brain and Coverings: Recordings from specific areas of CNS	<a href="#">EVHPAZ</a> 108,317,2000
inhalation rat	lethal concentration (50 percent kill): 140,700 mg/m <sup>3</sup> /1 hour	N/R	<a href="#">VCVGH*</a> -,441,1990
inhalation rat	lowest published lethal concentration: 30,000 mg/m <sup>3</sup> /4 hour	N/R	<a href="#">VCVGH*</a> -,442,1990
inhalation rat	lowest published toxic concentration: 1,000 ppm/4 hour	Brain and Coverings: Changes in surface EEG  Peripheral Nerve and Sensation: Sensory syndrome diagnostic of central lesion  Eye: Other eye effects	<a href="#">TOSCF2</a> 76,121,2003
inhalation rat	lowest published lethal concentration: 5,000 ppm/6 hour	N/R	<a href="#">TOXID9</a> 44,456,2005
inhalation rabbit	lowest published lethal concentration: 11,000 ppm	N/R	<a href="#">FAONAU</a> 48A,121,1970
inhalation rabbit	lowest published lethal concentration: 107,000 mg/m <sup>3</sup> /2 hour	N/R	<a href="#">VCVGH*</a> -,441,1990
inhalation rabbit	lowest published lethal	N/R	<a href="#">VCVGH*</a> -,441,1990

	concentration: 53,500 mg/m <sup>3</sup> /150 minute		
inhalation rabbit	lowest published lethal concentration: 26,750 mg/m <sup>3</sup> /14 hour	N/R	<a href="#">VCVGH*</a> -,441,1990
intraperitoneal dog	lethal dose (50 percent kill): 1,900 mg/kg	Liver: Liver function tests impaired	<a href="#">TXAPA9</a> 10,119,1967
intraperitoneal dog	lethal dose (50 percent kill): 2,725 mg/kg	N/R	<a href="#">VCVGH*</a> -,442,1990
intraperitoneal mouse	lethal dose (50 percent kill): 3,000 mg/kg	N/R	<a href="#">VCVGH*</a> -,442,1990
intraperitoneal mouse	lowest published toxic dose: 250 mg/kg	Lung, Thorax, or Respiration: Other changes  Liver: Other changes  Biochemical: Metabolism (intermediary): Other proteins	<a href="#">TOXID9</a> 72 (Suppl 1),322,2003
intraperitoneal mouse	lowest published toxic dose: 500 mg/kg	Lung, Thorax, or Respiration: Structural or functional change in trachea or bronchi	<a href="#">JPETAB</a> 316,520,2006
intraperitoneal mouse	lowest published toxic dose: 50 mg/kg	Lung, Thorax, or Respiration: Other changes  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Other oxidoreductases	<a href="#">JPETAB</a> 316,520,2006
intraperitoneal mouse		Behavioral: Muscle weakness	<a href="#">JTCTDW</a> 42,752,2004

	lowest published toxic dose: 2,250 mg/kg	Behavioral: Ataxia Behavioral: Alteration of classical conditioning	
intraperitoneal mouse	lowest published toxic dose: 3,222 mg/kg	Behavioral: Ataxia Behavioral: Alteration of classical conditioning	<a href="#">JTCTDW</a> 42,753,2004
intraperitoneal mouse	lowest published toxic dose: 1,720 mg/kg	Behavioral: Muscle weakness	<a href="#">JTCTDW</a> 42,753,2004
intraperitoneal rat	lethal dose (50 percent kill): 1,282 mg/kg	N/R	<a href="#">ENVRAL</a> 40,411,1986
intratracheal rat	lowest published lethal dose: 150 mg/kg	N/R	<a href="#">NTIS**</a> OTS0520615
intravenous dog	lowest published lethal dose: 150 mg/kg	N/R	<a href="#">QJPPAL</a> 7,205,1934
intravenous mouse	lethal dose (50 percent kill): 33,900 µg/kg	N/R	<a href="#">CBCCT*</a> 6,141,1954
intravenous rat	lethal dose (50 percent kill): 2,725 mg/kg	N/R	<a href="#">VCVGH*</a> -,442,1990
oral cat	lowest published lethal dose: 5,864 mg/kg	N/R	<a href="#">HBTXAC</a> 5,76,1959
oral dog	lethal dose (50 percent kill): 5,680 mg/kg	N/R	<a href="#">VCVGH*</a> -,442,1990
oral human	lowest published lethal dose: 7 gm/kg	N/R	<a href="#">ARTODN</a> 35,295,1976
oral human			<a href="#">VCVGH*</a> -,443,1990

	lowest published lethal dose: 7,000 mg/kg	Cardiac: Arrhythmias (including changes in conduction)	
oral man	lowest published toxic dose: 1 mL/kg	Behavioral: Somnolence (general depressed activity) Behavioral: Tremor Behavioral: Coma	<a href="#">TOSCF2</a> 41,157,1998
oral man	lowest published toxic dose: 2,143 mg/kg	Gastrointestinal: Other changes	<a href="#">34ZIAG</a> -,602,1969
oral mouse	lethal dose (50 percent kill): 2,402 mg/kg	Behavioral: Altered sleep time (including change in righting reflex) Behavioral: Ataxia Skin and Appendages: Other: Hair	<a href="#">NTIS**</a> AD-A080-636
oral mouse	lethal dose (50 percent kill): 2,400 mg/kg	N/R	<a href="#">VCVGH*</a> -,442,1990
oral mouse	lethal dose : 1,500 mg/kg	N/R	<a href="#">TOXID9</a> 78,365,2004
oral mouse	lowest published toxic dose: 1,500 mg/kg	Lung, Thorax, or Respiration: Respiratory depression	<a href="#">TOXID9</a> 90,178,2006
oral rat	lowest published toxic dose: 250 mg/kg	Biochemical: Metabolism (intermediary): Xanthine, purine or nucleotides including urate	<a href="#">ABCPO*</a> 47,1129,2000
oral rat	lethal dose (50 percent kill): 4,920 mg/kg	N/R	<a href="#">VCVGH*</a> -,442,1990
oral rat	lowest published toxic dose: 1,200 mg/kg	Behavioral: Alteration of classical conditioning	<a href="#">TOXID9</a> 44,428,2005

oral rat	lowest published toxic dose: 1,500 mg/kg	Lung, Thorax, or Respiration: Sputum  Lung, Thorax, or Respiration: Other changes  Biochemical: Metabolism (intermediary): Effect on inflammation or mediation of inflammation	<a href="#">TOXID9</a> 90,178,2006
oral rabbit	lowest published lethal dose: 7,330 mg/kg	N/R	<a href="#">HBTXAC</a> 5,76,1959
subcutaneous dog	lowest published lethal dose: 150 mg/kg	N/R	<a href="#">HBTXAC</a> 5,76,1959
subcutaneous mouse	lethal dose (50 percent kill): 16 gm/kg	Behavioral: Sleep  Behavioral: Ataxia	<a href="#">JPETAB</a> 123,224,1958
subcutaneous mouse	lethal dose (50 percent kill): 1,440 mg/kg	N/R	<a href="#">VCVGH*</a> -,442,1990
subcutaneous rabbit	lowest published lethal dose: 1,800 mg/kg	N/R	<a href="#">QJPPAL</a> 7,205,1934
skin mouse	lowest published toxic dose: 800 µL/kg	Skin: After topical application: Primary irritation	<a href="#">TXCYAC</a> 248,113,2008
skin rabbit	lethal dose (50 percent kill): >20 gm/kg	N/R	<a href="#">NTIS**</a> AD- A062-138
skin rabbit	lethal dose (50 percent kill): 20 mL/kg	N/R	<a href="#">VCVGH*</a> -,442,1990

## OTHER MULTIPLE DOSE DATA AND REFERENCES:

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE
inhalation dog	lowest published toxic concentration: 3,825 mg/m <sup>3</sup> /8 hour/6 week- intermittent	Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">TXAPA9</a> 10,270,1967
inhalation dog	lowest published toxic concentration: 500 ppm/4 hour/8 week- intermittent	Liver: Other changes	<a href="#">JIHTAB</a> 26 (7),250,1944
inhalation guinea pig	lowest published toxic concentration: 400 ppm/7 hour/35 week- intermittent	Liver: Changes in liver weight  Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">AMIHBC</a> 4,469,1951
inhalation gerbil	lowest published toxic concentration: 150 ppm/24 hour/30 day- continuous	Brain and Coverings: Other degenerative changes  Liver: Changes in liver weight  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Phosphatases	<a href="#">TOLED5</a> 10,1,1982
inhalation gerbil	lowest published toxic concentration: 320 ppm/24 hour/90 day- continuous	Brain and Coverings: Other degenerative changes  Biochemical: Metabolism (intermediary): Lipids including transport	<a href="#">NEPADD</a> 3,151,1985
inhalation gerbil	lowest published toxic concentration: 510	Brain and Coverings: Other degenerative changes  Biochemical: Metabolism	<a href="#">SWEHDO</a> 10,89,1984

	ppm/8 hour/24 week- intermittent	(intermediary): Lipids including transport  Biochemical: Metabolism (intermediary): Other proteins	
inhalation gerbil	lowest published toxic concentration: 170 ppm/8 hour/24 week- continuous	Brain and Coverings: Other degenerative changes  Biochemical: Metabolism (intermediary): Lipids including transport  Biochemical: Metabolism (intermediary): Other proteins	<a href="#">SWEHDO</a> 10,89,1984
inhalation man	lowest published toxic concentration: 5 ppm/17 year- intermittent	Liver: Change in gall bladder structure or function  Blood: Changes in serum composition (e.g. TP, bilirubin, cholesterol)	<a href="#">BJIMAG</a> 49,700,1992
inhalation mouse	lowest published toxic concentration: 150 ppm/24 hour/30 day- continuous	Liver: Changes in liver weight  Nutritional and Gross Metabolic: Weight loss or decreased weight gain  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Phosphatases	<a href="#">TOLED5</a> 10,1,1982
inhalation mouse	lowest published toxic concentration: 10,000 ppm/1 hour/12 day- intermittent	Lung, Thorax, or Respiration: Respiratory depression  Lung, Thorax, or Respiration: Other changes	<a href="#">BJPCAL</a> 4,177,1949

		Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	
inhalation mouse	lowest published toxic concentration: 500 ppm/4 week- intermittent	Liver: Hepatitis (hepatocellular necrosis), zonal  Endocrine: Other changes  Immunological Including Allergic: Decrease in humoral immune response	<a href="#">JJATDK</a> 20,471,2000
inhalation mouse	lowest published toxic concentration: 810 mg/m <sup>3</sup> /2 day- continuous	Liver: Changes in liver weight	<a href="#">VCVGH*</a> -,444,1990
inhalation mouse	lowest published toxic concentration: 37 ppm/8 hour/30 day- continuous	Liver: Changes in liver weight	<a href="#">EVHPAZ</a> 108,323,2000
inhalation mouse	lowest published toxic concentration: 300 ppm/7 hour/104 week- intermittent	Liver: Tumors  Tumorigenic: Increased incidence of tumors in susceptible strains	<a href="#">EVHPAZ</a> 108,343,2000
inhalation mouse	lowest published toxic concentration: 600 ppm/104 week- intermittent	Liver: Tumors  Tumorigenic: Increased incidence of tumors in susceptible strains	<a href="#">EVHPAZ</a> 108,343,2000
inhalation mouse	lowest published toxic concentration: 150 ppm/7 hour/107 week- intermittent	Lung, Thorax, or Respiration: Tumors  Tumorigenic: Increased incidence of tumors in susceptible strains	<a href="#">EVHPAZ</a> 108,343,2000
inhalation mouse	lowest published toxic	Lung, Thorax, or Respiration: Tumors	<a href="#">EVHPAZ</a> 108,343,2000

	concentration: 300 ppm/7 hour/78 week- intermittent	Tumorigenic: Increased incidence of tumors in susceptible strains	
inhalation mouse	lowest published toxic concentration: 150 ppm/6 hour/104 week- intermittent	Lung, Thorax, or Respiration: Tumors  Lung, Thorax, or Respiration: Bronchogenic carcinoma  Tumorigenic: Tumor types after systemic administration not seen spontaneously	<a href="#">EVHPAZ</a> 108,261,2000
inhalation mouse	lowest published toxic concentration: 600 ppm/7 hour/78 week- intermittent	Lung, Thorax, or Respiration: Tumors  Tumorigenic: Tumor types after systemic administration not seen spontaneously	<a href="#">EVHPAZ</a> 108,261,2000
inhalation mouse	lowest published toxic concentration: 450 ppm/5 day- intermittent	Lung, Thorax, or Respiration: Other changes  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Cytochrome oxidases (including oxidative phosphorylation)	<a href="#">EVHPAZ</a> 108,261,2000
inhalation mouse	lowest published toxic concentration: 1,000 ppm/4 week- intermittent	Reproductive: Paternal effects: Testes, epididymis, sperm duct	<a href="#">TXAPA9</a> 182,244,2002
inhalation mouse	lowest published toxic concentration:	Reproductive: Paternal effects: Testes, epididymis, sperm duct	<a href="#">TOXID9</a> 72,273,2003

	1,000 ppm/1 week-continuous		
inhalation mouse	lowest published toxic concentration: 1,000 ppm/5 day-intermittent	Kidney, Ureter, and Bladder: Other changes in urine composition	<a href="#">TOXID9</a> 66,60,2002
inhalation mouse	lowest published toxic concentration: 1,000 ppm/4 week-intermittent	Reproductive: Paternal effects: Testes, epididymis, sperm duct  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Cytochrome oxidases (including oxidative phosphorylation)	<a href="#">TOXID9</a> 66,60,2002
inhalation rat	lowest published toxic concentration: 4,380 ppm/4 hour/2 week-intermittent	Behavioral: Ataxia  Behavioral: Change in psychophysiological tests	<a href="#">AIHAAP</a> 25,369,1964
inhalation rat	lowest published toxic concentration: 3,200 ppm/12 hour/14 week-intermittent	Brain and Coverings: Recordings from specific areas of CNS  Ear: Change in acuity	<a href="#">NETEEC</a> 13,83,1991
inhalation rat	lowest published toxic concentration: 150 ppm/24 hour/30 day- continuous	Liver: Changes in liver weight	<a href="#">TOLED5</a> 10,1,1982
inhalation rat	lowest published toxic concentration: 2,400 ppm/6 hour/13 week-intermittent	Ear: Change in acuity	<a href="#">FAATDF</a> 38,101,1997

inhalation rat	lowest published toxic concentration: 50 mg/m <sup>3</sup> /5 hour/26 week- intermittent	Brain and Coverings: Recordings from specific areas of CNS  Kidney, Ureter, and Bladder: Other changes in urine composition	<a href="#">GTPZAB</a> 5 (3),9,1961
inhalation rat	lowest published toxic concentration: 300 ppm/24 hour/12 week- continuous	Blood: Changes in serum composition (e.g. TP, bilirubin, cholesterol)  Liver: Changes in liver weight  Biochemical: Metabolism (intermediary): Lipids including transport	<a href="#">ETPAEK</a> 46,133,1994
inhalation rat	lowest published toxic concentration: 2,000 ppm/1 hour/10 day- intermittent	Behavioral: Alteration of operant conditioning  Behavioral: Tolerance	<a href="#">NETEEC</a> 23,617,2001
inhalation rat	lowest published toxic concentration: 2,000 ppm/5 day- intermittent	Behavioral: Tolerance  Behavioral: Alteration of operant conditioning	<a href="#">NETEEC</a> 22,221,2000
inhalation rat	lowest published toxic concentration: 376 ppm/30 day- intermittent	Behavioral: Change in motor activity (specific assay)	<a href="#">JAPTO*</a> 21,441,2001
inhalation rat	lowest published toxic concentration: 500 ppm/6 hour/26 week- intermittent	Kidney, Ureter, and Bladder: Changes in both tubules and glomeruli  Kidney, Ureter, and Bladder: Other changes in urine composition	<a href="#">TOLED5</a> -,247,2002

inhalation rat	lowest published toxic concentration: 600 ppm/7 hour/104 week- intermittent	Kidney, Ureter, and Bladder: Bladder tumors  Tumorigenic: Tumor types after systemic administration not seen spontaneously	<a href="#">EVHPAZ</a> 108,225,2000
inhalation rat	lowest published toxic concentration: 3,200 ppm/6 hour/1 week- intermittent	Ear: Change in acuity  Ear: Change in cochlear structure or function	<a href="#">EVHPAZ</a> 108,317,2000
inhalation rat	lowest published toxic concentration: 3,200 ppm/6 hour/4 week- intermittent	Ear: Change in acuity  Ear: Change in cochlear structure or function	<a href="#">EVHPAZ</a> 108,317,2000
inhalation rat	lowest published toxic concentration: 2,400 ppm/6 hour/13 week- intermittent	Ear: Change in acuity  Ear: Change in cochlear structure or function	<a href="#">EVHPAZ</a> 108,317,2000
inhalation rat	lowest published toxic concentration: 50 ppm/8 hour/6 week- intermittent	Brain and Coverings: Changes in surface EEG  Cardiac: Pulse rate decreased with fall in BP	<a href="#">EVHPAZ</a> 108,323,2000
inhalation rat	lowest published toxic concentration: 300 ppm/7 hour/104 week- intermittent	Kidney, Ureter, and Bladder: Changes in tubules (including acute renal failure, acute tubular necrosis)  Kidney, Ureter, and Bladder: Other changes	<a href="#">EVHPAZ</a> 108,323,2000
inhalation rat	lowest published toxic	Kidney, Ureter, and Bladder: Bladder tumors	<a href="#">EVHPAZ</a> 108,343,2000

	concentration: 600 ppm/7 hour/104 week- intermittent	Tumorigenic: Increased incidence of tumors in susceptible strains	
inhalation rat	lowest published toxic concentration: 500 ppm/182 day- intermittent	Kidney, Ureter, and Bladder: Interstitial nephritis  Kidney, Ureter, and Bladder: Renal function tests depressed	<a href="#">TOLED5</a> 128,243,2002
inhalation rat	lowest published toxic concentration: 500 ppm/6 hour/26 week- intermittent	Brain and Coverings: Other degenerative changes	<a href="#">ETOPFR</a> 12,157,2002
inhalation rat	lowest published toxic concentration: 600 ppm/6 hour/15 day- intermittent	Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">TOXID9</a> 66,237,2002
inhalation rat	lowest published toxic concentration: 600 ppm/3 day- intermittent	Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">BDERB*</a> 77,405,2006
inhalation rabbit	lowest published toxic concentration: 350 ppm/4 hour/12 week- intermittent	Brain and Coverings: Recordings from specific areas of CNS	<a href="#">NRTXDN</a> 13,203,1992
inhalation rabbit	lowest published toxic concentration: 100 mg/m <sup>3</sup> /4 hour/39 week- intermittent	Kidney, Ureter, and Bladder: Other changes in urine composition  Blood: Changes in leukocyte (WBC) count  Biochemical: Enzyme inhibition, induction, or	<a href="#">GTPZAB</a> 17 (5),55,1973

		change in blood or tissue levels: Other esterases	
intramuscular rat	lowest published toxic dose: 125 gm/kg/10 week-intermittent	Peripheral Nerve and Sensation: Structural change in nerve or sheath  Biochemical: Metabolism (intermediary): Lipids including transport	<a href="#">NRTXDN</a> 13,601,1992
intramuscular rat	lowest published toxic dose: 1,720 mg/m <sup>3</sup> /5 day-continuous	Brain and Coverings: Other degenerative changes  Biochemical: Metabolism (intermediary): Lipids including transport	<a href="#">TXAPA9</a> 85,145,1986
intraperitoneal mouse	lowest published toxic dose: 3,941 mg/kg/3 day-intermittent	Endocrine: Changes in spleen weight	<a href="#">TXCYAC</a> 70,231,1991
oral mouse	lowest published toxic dose: 48 gm/kg/4 week-intermittent	Liver: Hepatitis (hepatocellular necrosis), zonal  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Dehydrogenases  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Transaminases	<a href="#">JJATDK</a> 9,15,1986
oral mouse	lowest published toxic dose: 49,080 mg/kg/17 week-continuous	Blood: Changes in bone marrow not included in above  Immunological Including Allergic: Decrease in humoral immune response	<a href="#">NTIS**</a> AD-A080-636

oral mouse	lowest published toxic dose: 182 gm/kg/26 week-continuous	<p>Liver: Changes in liver weight</p> <p>Kidney, Ureter, and Bladder: Changes in bladder weight</p> <p>Nutritional and Gross Metabolic: Weight loss or decreased weight gain</p>	<a href="#">TXAPA9</a> 62,351,1982
oral mouse	lowest published toxic dose: 13 gm/kg/5 day-intermittent	<p>Nutritional and Gross Metabolic: Weight loss or decreased weight gain</p> <p>Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Hepatic microsomal mixed oxidase (dealkylation, hydroxylation, etc.)</p> <p>Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field</p>	<a href="#">TXAPA9</a> 62,351,1982
oral mouse	lowest published toxic dose: 102,900 mg/kg /21 week- continuous	<p>Liver: Changes in liver weight</p> <p>Reproductive: Paternal effects: Testes, epididymis, sperm duct</p> <p>Reproductive: Paternal effects: Prostate, seminal vesicle, Cowper's gland, accessory glands</p>	<a href="#">NTIS**</a> #PB86161999
oral mouse	lowest published toxic dose: 102,900 mg/kg /21 week- continuous	Kidney, Ureter, and Bladder: Changes in tubules (including acute renal failure, acute tubular necrosis)	<a href="#">NTIS**</a> #PB86173150

		Reproductive: Paternal effects: Spermatogenesis (including genetic material, sperm morphology, motility, and count)	
oral mouse	lowest published toxic dose: 102,900 mg/kg/21 week- continuous	Liver: Changes in liver weight  Kidney, Ureter, and Bladder: Changes in tubules (including acute renal failure, acute tubular necrosis)	<a href="#">NTIS**</a> #PB86173150
oral mouse	lowest published toxic dose: 3,000 mg/kg/6 week- intermittent	Liver: Changes in liver weight	<a href="#">EVHPAZ</a> 108,323,2000
oral mouse	lowest published toxic dose: 44,800 mg/kg/16 week- continuous	Immunological Including Allergic: Decrease in cellular immune response  Immunological Including Allergic: Hypersensitivity delayed (multiple organ involvement)	<a href="#">EVHPAZ</a> 108,323,2000
oral mouse	lowest published toxic dose: 67,200 mg/kg/24 week- continuous	Immunological Including Allergic: Decrease in cellular immune response  Immunological Including Allergic: Hypersensitivity delayed (multiple organ involvement)	<a href="#">EVHPAZ</a> 108,323,2000
oral mouse	lowest published toxic dose: 735,000 mg/kg/105 week- continuous	Liver: Tumors  Tumorigenic: Increased incidence of tumors in susceptible strains	<a href="#">EVHPAZ</a> 108,335,2000
		Liver: Tumors	

oral mouse	lowest published toxic dose: 1,312.8 mg/kg/78 week-intermittent		<a href="#">EVHPAZ</a> 108,241,2000
oral mouse	lowest published toxic dose: 984.6 mg/kg/78 week-intermittent	Liver: Tumors  Tumorigenic: Tumor types after systemic administration not seen spontaneously	<a href="#">EVHPAZ</a> 108,241,2000
oral mouse	lowest published toxic dose: 525 gm/kg/105 week-intermittent	Liver: Tumors	<a href="#">EVHPAZ</a> 108,241,2000
oral mouse	lowest published toxic dose: 24,000 mg/kg/24 week-continuous	Liver: Changes in liver weight	<a href="#">EVHPAZ</a> 108,241,2000
oral mouse	lowest published toxic dose: 7 gm/kg/1 week-intermittent	Liver: Other changes  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Isomerases	<a href="#">TXCYAC</a> 173,229,2002
oral mouse	lowest published toxic dose: 84 gm/kg/12 week-continuous	Immunological Including Allergic: Autoimmune (multiple organ involvement)	<a href="#">TXAPA9</a> 197,279,2004
oral mouse	lowest published toxic dose: 4,500 mg/kg/3 day-intermittent	Liver: Changes in liver weight  Kidney, Ureter, and Bladder: Changes in kidney weight  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Other oxidoreductases	<a href="#">TXCYAC</a> 203,83,2004

oral mouse	lowest published toxic dose: 4,500 mg/kg/3 day-intermittent	Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">TXCYAC</a> 203,83,2004
oral mouse	lowest published toxic dose: 2,250 mg/kg/3 day-intermittent	Liver: Other changes  Kidney, Ureter, and Bladder: Other changes  Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">TOXID9</a> 78,365,2004
oral mouse	lowest published toxic dose: 3,000 mg/kg/5 day-intermittent	Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">TOXID9</a> 78,365,2004
oral mouse	lowest published toxic dose: 560 mg/kg/4 week-continuous	Blood: Changes in serum composition (e.g. TP, bilirubin, cholesterol)  Immunological Including Allergic: Autoimmune (multiple organ involvement)  Biochemical: Metabolism (intermediary): Other	<a href="#">TOXID9</a> 60,206,2001
oral mouse	lowest published toxic dose: 22,400 µg/kg/16 week-continuous	Immunological Including Allergic: Decrease in humoral immune response  Immunological Including Allergic: Autoimmune (multiple organ involvement)	<a href="#">TOXID9</a> 60,141,2001
oral mouse	lowest published toxic dose: 36,400 µg/kg/26 week-continuous	Blood: Other changes	<a href="#">TOXID9</a> 60,141,2001

oral mouse	lowest published toxic dose: 210 mg/kg/3 week-intermittent	Liver: Other changes  Liver: Changes in liver weight  Kidney, Ureter, and Bladder: Changes in kidney weight	<a href="#">TOXID9</a> 60,159,2001
oral mouse	lowest published toxic dose: 31,500 mg/kg/3 week-intermittent	Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">TOXID9</a> 60,159,2001
oral mouse	lowest published toxic dose: 21,000 mg/kg/2 week-intermittent	Liver: Other changes  Biochemical: Metabolism (intermediary): Other	<a href="#">TOXID9</a> 90,178,2006
oral mouse	lowest published toxic dose: 1,400 mg/kg/14 day-intermittent	Liver: Changes in liver weight	<a href="#">NTPTR*</a> IMM-98010
oral mouse	lowest published toxic dose: 18,200 mg/kg/26 week-continuous	Liver: Multiple effects  Immunological Including Allergic: Autoimmune (multiple organ involvement)  Biochemical: Metabolism (intermediary): Effect on inflammation or mediation of inflammation	<a href="#">TOXID9</a> -,12,2008
oral mouse	lowest published toxic dose: 16,800 mg/kg/24 week-continuous	Lung, Thorax, or Respiration: Other changes  Liver: Other changes  Kidney, Ureter, and Bladder: Other changes	<a href="#">TOXID9</a> -,71,2008
oral mouse	lowest published toxic dose: 25,200	Lung, Thorax, or Respiration: Other changes	<a href="#">TOXID9</a> -,71,2008

	mg/kg/36 week-continuous	Liver: Other changes  Biochemical: Metabolism (intermediary): Effect on inflammation or mediation of inflammation	
oral mouse	lowest published toxic dose: 25.2 gm/kg/36 week-continuous	Nutritional and Gross Metabolic: Weight loss or decreased weight gain  Biochemical: Metabolism (intermediary): Effect on inflammation or mediation of inflammation  Liver: Other changes	<a href="#">TXAPA9</a> 228,68,2008
oral mouse	lowest published toxic dose: 2.8 mg/kg/4 week-continuous	Immunological Including Allergic: Increase in humoral response  Immunological Including Allergic: Autoimmune (multiple organ involvement)  Biochemical: Metabolism (intermediary): Effect on inflammation or mediation of inflammation	<a href="#">TOXID9</a> 12,437,2008
oral mouse	lowest published toxic dose: 22.4 mg/kg/32 week-continuous	Liver: Hepatitis (hepatocellular necrosis), diffuse  Skin: After systemic exposure: Dermatitis, other  Immunological Including Allergic: Autoimmune (multiple organ involvement)	<a href="#">TOXID9</a> 12,437,2008

oral rat	lowest published toxic dose: 1,160 mg/kg/8 week- intermittent	Brain and Coverings: Demyelination	<a href="#">NETEEC</a> 12,375,1990
oral rat	lowest published toxic dose: 84 gm/kg/2 week- continuous	Liver: Changes in liver weight  Kidney, Ureter, and Bladder: Changes in bladder weight  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Hepatic microsomal mixed oxidase (dealkylation, hydroxylation, etc.)	<a href="#">TOXID9</a> 5,228,1985
oral rat	lowest published toxic dose: 130 gm/kg/13 week- intermittent	Nutritional and Gross Metabolic: Weight loss or decreased weight gain  Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">NTPTR*</a> NTP- TR-273,1988
oral rat	lowest published toxic dose: 24 gm/kg/6 week- intermittent	Liver: Changes in liver weight  Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Phosphatases	<a href="#">TXAPA9</a> 78,105,1985
oral rat	lowest published toxic dose: 28 gm/kg/28 day- intermittent	Liver: Changes in liver weight  Blood: Pigmented or nucleated red blood cells  Biochemical: Enzyme inhibition, induction, or	<a href="#">NTIS**</a> OTS0590061

		change in blood or tissue levels: Phosphatases	
oral rat	lowest published toxic dose: 14,000 mg/kg/7 day-intermittent	Liver: Changes in liver weight  Endocrine: Changes in spleen weight  Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">JTPAE7</a> 29,451,2001
oral rat	lowest published toxic dose: 2,128 mg/kg/28 day-continuous	Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">NTIS**</a> #PB86190782
oral rat	lowest published toxic dose: 42,483 mg/kg/21 week-continuous	Liver: Changes in liver weight  Kidney, Ureter, and Bladder: Changes in kidney weight  Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">NTIS**</a> #PB86190782
oral rat	lowest published toxic dose: 257.5 gm/kg/103 week-intermittent	Kidney, Ureter, and Bladder: Bladder tumors  Tumorigenic: Tumor types after systemic administration not seen spontaneously  Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">EVHPAZ</a> 108,225,2000
oral rat	lowest published toxic dose: 515 gm/kg/103 week-intermittent	Kidney, Ureter, and Bladder: Changes in tubules (including acute renal failure, acute tubular	<a href="#">EVHPAZ</a> 108,225,2000

		necrosis)  Kidney, Ureter, and Bladder: Bladder tumors  Tumorigenic: Tumor types after systemic administration not seen spontaneously	
oral rat	lowest published toxic dose: 700 mg/kg/14 day-intermittent	Liver: Changes in liver weight	<a href="#">EVHPAZ</a> 108,323,2000
oral rat	lowest published toxic dose: 65,000 mg/kg/52 week-intermittent	Kidney, Ureter, and Bladder: Changes in tubules (including acute renal failure, acute tubular necrosis)  Kidney, Ureter, and Bladder: Other changes	<a href="#">EVHPAZ</a> 108,323,2000
oral rat	lowest published toxic dose: 6.3 gm/kg/2 week-continuous	Reproductive: Effects on fertility: Other measures of fertility	<a href="#">REPTED</a> 17,273,2003
oral rat	lowest published toxic dose: 21,000 mg/kg/2 week-intermittent	Liver: Other changes  Biochemical: Metabolism (intermediary): Other	<a href="#">TOXID9</a> 90,178,2006
oral rat	lowest published toxic dose: 20 gm/kg/8 week-intermittent	Liver: Changes in liver weight  Kidney, Ureter, and Bladder: Changes in kidney weight  Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">NTPTR*</a> IMM-96007

oral rat	lowest published toxic dose: 20 gm/kg/8 week- intermittent	Immunological Including Allergic: Autoimmune (multiple organ involvement)  Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">NTPTR*</a> IMM-96007
oral rat	lowest published toxic dose: 5,000 mg/kg/2 week- intermittent	Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">NTPTR*</a> IMM-96007
oral rat	lowest published toxic dose: 32,500 mg/kg/13 week- intermittent	Kidney, Ureter, and Bladder: Urine volume increased	<a href="#">TXCYAC</a> 224,108,2006
oral rat	lowest published toxic dose: 16,250 mg/kg/13 week- intermittent	Kidney, Ureter, and Bladder: Changes in tubules (including acute renal failure, acute tubular necrosis)	<a href="#">TXCYAC</a> 224,108,2006
oral rat	lowest published toxic dose: 7,000 mg/kg/14 day- intermittent	Liver: Changes in liver weight  Kidney, Ureter, and Bladder: Changes in kidney weight  Nutritional and Gross Metabolic: Weight loss or decreased weight gain	<a href="#">TXAPA9</a> 225,171,2007
oral rat	lowest published toxic dose: 21,000 mg/kg/14 day- intermittent	Blood: Changes in other cell count (unspecified)  Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">TXAPA9</a> 225,171,2007
subcutaneous rat	lowest published toxic dose: 60	Liver: Other changes  Liver: Changes in liver	<a href="#">INHEAO</a> 25,89,1987

	gm/kg/15 week-intermittent	weight  Biochemical: Metabolism (intermediary): Other proteins	
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**REVIEWS:**

ORGANIZATION	STANDARD	REFERENCE
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value	time-weighted average 10 ppm; short term exposure limit 25 ppm	<a href="#">DTLVS*</a> TLV/BEI, 2007
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value	Suspected human carcinogen	<a href="#">DTLVS*</a> TLV/BEI, 2007
International Agency for Research on Cancer (IARC) Cancer Review	Animal Limited Evidence	<a href="#">IMEMDT</a> 20,545,1979
International Agency for Research on Cancer (IARC) Cancer Review	Animal Sufficient Evidence	<a href="#">IMEMDT</a> 63,75,1995
International Agency for Research on Cancer (IARC) Cancer Review	Human Limited Evidence	<a href="#">IMEMDT</a> 63,75,1995
International Agency for Research on Cancer (IARC) Cancer Review	Human Inadequate Evidence	<a href="#">IMEMDT</a> 20,545,1979
International Agency for Research on Cancer (IARC) Cancer Review	Group 3	<a href="#">IMSUDL</a> 7,364,1987
International Agency for Research on Cancer (IARC) Cancer Review	Group 2A	<a href="#">IMEMDT</a> 63,75,1995
TOXICOLOGY REVIEW		<a href="#">TOLED5</a> 127,111,2002
TOXICOLOGY REVIEW		<a href="#">CLPTAT</a> 8,91,1967
TOXICOLOGY REVIEW		<a href="#">JJOMDZ</a> 16,194,1974

TOXICOLOGY REVIEW		<a href="#"><u>JJOMDZ</u></a> 17,603,1975
TOXICOLOGY REVIEW		<a href="#"><u>FNSCA6</u></a> 2,67,1973
TOXICOLOGY REVIEW		<a href="#"><u>BNYMAM</u></a> 54,413,1978
TOXICOLOGY REVIEW		<a href="#"><u>FAATDF</u></a> 13,747,1989
TOXICOLOGY REVIEW		<a href="#"><u>NTOTDY</u></a> 3,417,1981
TOXICOLOGY REVIEW		<a href="#"><u>CRTXB2</u></a> 30,253,2000
TOXICOLOGY REVIEW		<a href="#"><u>EVHPAZ</u></a> 108,323,2000
TOXICOLOGY REVIEW		<a href="#"><u>EVHPAZ</u></a> 108,343,2000
TOXICOLOGY REVIEW		<a href="#"><u>EVHPAZ</u></a> 108,241,2000
TOXICOLOGY REVIEW		<a href="#"><u>EVHPAZ</u></a> 108,261,2000
TOXICOLOGY REVIEW		<a href="#"><u>TOLED5</u></a> 127,321,2002
TOXICOLOGY REVIEW		<a href="#"><u>TOLED5</u></a> 134,17,2002
TOXICOLOGY REVIEW		<a href="#"><u>MUREAV</u></a> 543,201,2003
TOXICOLOGY REVIEW		<a href="#"><u>TOLED5</u></a> 140- 141,43,2003
TOXICOLOGY REVIEW		<a href="#"><u>TOLED5</u></a> 140- 141,53,2003
TOXICOLOGY REVIEW		<a href="#"><u>MUREAV</u></a> 567,227,2004
TOXICOLOGY REVIEW		<a href="#"><u>MUREAV</u></a> 567,109,2004
TOXICOLOGY REVIEW		<a href="#"><u>MUTAEX</u></a> 14,5,1999

TOXICOLOGY REVIEW		<a href="#"><u>EMMUEG</u></a> 39,69,2002
TOXICOLOGY REVIEW		<a href="#"><u>CRTXB2</u></a> 33,137,2003
TOXICOLOGY REVIEW		<a href="#"><u>MUTAEX</u></a> 14,271,1999
TOXICOLOGY REVIEW		<a href="#"><u>TXCYAC</u></a> 196,1,2004
TOXICOLOGY REVIEW		<a href="#"><u>DIMON*</u></a> 39,678,1993
TOXICOLOGY REVIEW		<a href="#"><u>MUREAV</u></a> 628,31,2007
TOXICOLOGY REVIEW		<a href="#"><u>FCTOD7</u></a> 44,1699,2006
TOXICOLOGY REVIEW		<a href="#"><u>MUREAV</u></a> 627,59,2007
TOXICOLOGY REVIEW		<a href="#"><u>ENTOX*</u></a> -,382,2005
TOXICOLOGY REVIEW		<a href="#"><u>BCLPT*</u></a> 96,131,2005
TOXICOLOGY REVIEW		<a href="#"><u>MUTAEX</u></a> 20,245,2005
TOXICOLOGY REVIEW		<a href="#"><u>MUREAV</u></a> 584,1,2005
TOXICOLOGY REVIEW		<a href="#"><u>HETOEa</u></a> 25,413,2006
TOXICOLOGY REVIEW		<a href="#"><u>MUREAV</u></a> 658,124,2008
TOXICOLOGY REVIEW		<a href="#"><u>JTEHD6</u></a> 6,257,2003
TOXICOLOGY REVIEW		<a href="#"><u>BDERE*</u></a> 73,931,2005
TOXICOLOGY REVIEW		<a href="#"><u>REPTED</u></a> 22,557,2006
TOXICOLOGY REVIEW		<a href="#"><u>MUREAV</u></a> 654,114,2008

TOXICOLOGY REVIEW		<a href="#">MUREAV</a> 654,114,2008
TOXICOLOGY REVIEW		<a href="#">HUTOX*</a> -,577,1996
TOXICOLOGY REVIEW		<a href="#">HUTOX*</a> -,577,1996

## STANDARDS AND REGULATIONS:

ORGANIZATION	STANDARD	REFERENCE
Mine Safety and Health Administration (MSHA) STANDARD - air	time-weighted average 100 ppm (535 mg/m <sup>3</sup> )	<a href="#">DTLVS*</a> 3,263,1971
Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (General Industry)	8 hour time-weighted average 100 ppm; ceiling concentration 200; peak concentration 300/5 minute/2 hour	<a href="#">CFRGBR</a> 29,1910.1000,1994
Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (Construction)	8 hour time-weighted average 100 ppm (535 mg/m <sup>3</sup> )	<a href="#">CFRGBR</a> 29,1926.55,1994
Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (Shipyards)	8 hour time-weighted average 100 ppm (535 mg/m <sup>3</sup> )	<a href="#">CFRGBR</a> 29,1915.1000,1993
Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (Federal Contractors)	8 hour time-weighted average 100 ppm (535 mg/m <sup>3</sup> )	<a href="#">CFRGBR</a> 41,50- 204.50,1994
Occupational Exposure Limit - AUSTRALIA	time-weighted average 10 ppm (54 mg/m <sup>3</sup> ), short term exposure limit 40 ppm (216 mg/m <sup>3</sup> ), JUL2008	

<b>Occupational Exposure Limit - BELGIUM</b>	<b>time-weighted average 50 ppm (273 mg/m<sup>3</sup>), MAR2002</b>
<b>Occupational Exposure Limit - BELGIUM</b>	<b>short term exposure limit 100 ppm (545 mg/m<sup>3</sup>), Carcinogen, MAR2002</b>
<b>Occupational Exposure Limit - DENMARK</b>	<b>time-weighted average 10 ppm (55 mg/m<sup>3</sup>), OCT 2002</b>
<b>Occupational Exposure Limit - FINLAND</b>	<b>time-weighted average 30 ppm (160 mg/m<sup>3</sup>), short term exposure limit 45 ppm (240 mg/m<sup>3</sup>), Skin, JAN1999</b>
<b>Occupational Exposure Limit - FRANCE</b>	<b>VME 75 ppm (405 mg/m<sup>3</sup>), VLE 200 ppm (1080 mg/m<sup>3</sup>), continuous<sup>2</sup> Carcinogen, FEB2006</b>
<b>Occupational Exposure Limit - HUNGARY</b>	<b>time-weighted average 270 mg/m<sup>3</sup>, short term exposure limit 540 mg/m<sup>3</sup>, SEP2000</b>
<b>Occupational Exposure Limit - JAPAN</b>	<b>Occupational Exposure Limit 25 ppm (135 mg/m<sup>3</sup>), 2B carcinogen, APR2007</b>
<b>Occupational Exposure Limit - KOREA</b>	<b>time-weighted average 50 ppm (270 mg/m<sup>3</sup>), short term exposure limit 200 ppm (1080 mg/m<sup>3</sup>), 2006</b>
<b>Occupational Exposure Limit - MEXICO</b>	<b>time-weighted average 100 ppm (535 mg/m<sup>3</sup>); short term exposure limit 200 ppm (1080 mg/m<sup>3</sup>), 2004</b>
<b>Occupational Exposure Limit - THE NETHERLANDS</b>	<b>MAC-TGG 190 mg/m<sup>3</sup>, 2003</b>
<b>Occupational Exposure Limit - NEW ZEALAND</b>	<b>time-weighted average 50 ppm (269 mg/m<sup>3</sup>), short term exposure limit 200 ppm (1070 mg/m<sup>3</sup>), JAN2002</b>
<b>Occupational Exposure Limit - NORWAY</b>	<b>time-weighted average 20 ppm (110 mg/m<sup>3</sup>), JAN1999</b>
<b>Occupational Exposure Limit - THE PHILIPPINES</b>	<b>time-weighted average 100 ppm (535 mg/m<sup>3</sup>), JAN1993</b>
<b>Occupational Exposure Limit - POLAND</b>	<b>MAC(time-weighted average) 50 mg/m<sup>3</sup>, MAC(short term exposure limit) 400 mg/m<sup>3</sup>, JAN1999</b>

Occupational Exposure Limit - RUSSIA	time-weighted average 10 mg/m <sup>3</sup> , short term exposure limit 30 mg/m <sup>3</sup> , JUN2003
Occupational Exposure Limit - SWEDEN	time-weighted average 10 ppm (50 mg/m <sup>3</sup> ); short term exposure limit 25 ppm (140 mg/m <sup>3</sup> ), Carcinogen, JUN2005
Occupational Exposure Limit - SWITZERLAND	MAK- week 50 ppm (260 mg/m <sup>3</sup> ),KZG- week 100 ppm (520 mg/m <sup>3</sup> ), dayEC2006
Occupational Exposure Limit - THAILAND	time-weighted average 100 ppm, short term exposure limit 200 ppm, JAN1993
Occupational Exposure Limit - TURKEY	time-weighted average 100 ppm (535 mg/m <sup>3</sup> ), JAN1993
Occupational Exposure Limit - UNITED KINGDOM	time-weighted average 100 ppm (550 mg/m <sup>3</sup> ); short term exposure limit 150 ppm (skin), 2005
Occupational Exposure Limit IN ARGENTINA, BULGARIA, COLOMBIA, JORDAN	American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value;  Suspected human carcinogen
Occupational Exposure Limit IN SINGAPORE, VIETNAM	American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value Suspected human carcinogen

## NIOSH DOCUMENTATION AND SURVEILLANCE:

ORGANIZATION	STANDARD or SURVEY	REFERENCE
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Level TO TRICHLOROETHYLENE-air	Carcinogen; 10 hour time-weighted average 25 ppm; ceiling concentration 2 ppm/1 hour	<a href="#">NIOSH*</a> DHHS #92-100,1992

National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Level TO WASTE ANESTHETIC GASES AND VAPORS-air	ceiling concentration 2 ppm/1 hour	<a href="#">MMWR**</a> 37 (S-7),28,1988
National Occupational Hazard Survey 1974	National Occupational Hazard Survey 1974: Hazard Code: 73790; Number of Industries 251; Total Number of Facilities 37,699; Number of Occupations 141; Total Number of Employees Exposed 446,588	
National Occupational Exposure Survey 1983	<a href="#">National Occupational Exposure Survey 1983: Hazard Code: 73790</a> <small>EXIT</small> ; Number of Industries 192; Total Number of Facilities 23,225; Number of Occupations 143; Total Number of Employees Exposed 401,373; Total Number of Female Employees Exposed 175,316	

## STATUS IN FEDERAL AGENCIES:

ORGANIZATION	REFERENCE
ATSDR TOXICOLOGY PROFILE (NTIS** PB/98/101165/AS)	
EPA GENETOX PROGRAM 1988, Positive: Cell transform.-RLV F344 rat embryo; Host-mediated assay	
EPA GENETOX PROGRAM 1988, Positive: Mouse spot test; Sperm morphology-mouse	
EPA GENETOX PROGRAM 1988, Positive: S cerevisiae gene conversion; S cerevisiae-homozygosis	
EPA GENETOX PROGRAM 1988, Positive: S cerevisiae-reversion	
EPA GENETOX PROGRAM 1988, Positive/limited: Carcinogenicity-mouse/rat	

EPA GENETOX PROGRAM 1988, Negative: D melanogaster Sex-linked lethal	
EPA GENETOX PROGRAM 1988, Inconclusive: Histidine reversion-Ames test	
EPA TSCA Section 8(b) CHEMICAL INVENTORY	
Used as a vapor degreaser of fabricated metal parts, as a solvent and as a drug	
EPA TSCA Section 8(d) unpublished health/safety studies	
On EPA IRIS database	
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 2001	
NIOSH CURRENT INTELLIGENCE BULLETIN 2, 1975	
NIOSH Analytical Method, 1994: Trichloroethylene, 1022; by portable GC, 3701	
NCI Carcinogenesis Studies (gavage); clear evidence: mouse	
NTP Carcinogenesis Studies (gavage); clear evidence: mouse	<a href="#">NTPTR*</a> NTP-TR-243, 1983
NCI Carcinogenesis Bioassay (gavage); no evidence: rat	<a href="#">NCITR*</a> NCI-TR-2, 1976
NCI Carcinogenesis Studies (gavage); inadequate study: rat	
NCI Carcinogenesis Studies (gavage); inadequate studies: rat	<a href="#">NTPTR*</a> NTP-TR-243, 1983
NTP 11th Report on Carcinogens, 2004: Reasonably anticipated to be a human carcinogen	
OSHA ANALYTICAL METHOD #1001	

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CODEN	REFERENCE
34ZIAG	"Toxicology of Drugs and Chemicals," Deichmann, W.B., New York, Academic Press, Inc., 1969
85JCAE	"Prehled Prumyslove Toxikologie; Organické Latky," Marhold, J., Prague, Czechoslovakia, Avicenum, 1986
ABCPO*	Acta Biochimica Polonica (Published by Polish Biochemical Society and the Committee of Biochemistry and Biophysics, Polish

	Academy of Sciences, Warszawa Panstwowe Wydawnictwo Naukowe, L.Pasteura 3 02-093 Warszawa, Poland) V.1- 1954-
<b>AGTQAH</b>	Annales de Genetique. (Expansion Scientifique Francaise, 15 rue Saint-Benoit, F-75278, Paris Cedex 06, France) V.1- 1958-
<b>AHBAAM</b>	Archiv fuer Hygiene und Bakteriologie. (Munich, Fed. Rep. Ger.) V.101-154, 1929-71. For publisher information, see ZHPMAT.
<b>AIHAAP</b>	American Industrial Hygiene Association Journal. (AIHA, 475 Wolf Ledges Pkwy., Akron, OH 44311) V.19- 1958-
<b>AMIHBC</b>	AMA Archives of Industrial Hygiene and Occupational Medicine. (Chicago, IL) V.2-10, 1950-54. For publisher information, see AEHLAU.
<b>ANESAV</b>	Anesthesiology. (Lippincott/Harper, Journal Fulfillment Dept., 2350 Virginia Ave., Hagerstown, MD 21740) V.1- 1940-
<b>APTOA6</b>	Acta Pharmacologica et Toxicologica. (Copenhagen, Denmark) V.1-59, 1945-86. For publisher information, see PHTOEH
<b>APTOD9</b>	Abstracts of Papers, Society of Toxicology. Annual Meetings. (Academic Press, Inc., 1 E. First St., Duluth, MN 55802)
<b>ARTODN</b>	Archives of Toxicology. (Springer-Verlag, Heidelberger Pl. 3, D-1000 Berlin 33, Fed. Rep. Ger.) V.32- 1974-
<b>BCLPT*</b>	Basic & clinical pharmacology & toxicology (Copenhagen, Denmark : Nordic Pharmacological Society Oxford, UK : Distributed by Blackwell Munksgaard) V.94- 2004-
<b>BCPCA6</b>	Biochemical Pharmacology. (Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, NY 10523) V.1- 1958-
<b>BDERB*</b>	
<b>BDERE*</b>	Birth Defects Research Part A, Clinical and molecular teratology (Hoboken, N.J. : John Wiley & Sons) V.67- 2003-
<b>BJANAD</b>	British Journal of Anesthesia. (Macmillan Press Ltd., Houndmills, Basingstoke, Hants. RG21 2XS, UK) V.1- 1923-
<b>BJIMAG</b>	British Journal of Industrial Medicine. (British Medical Journal, Box 560B, Kennebunkport, ME 04046) V.1- 1944-
<b>BJPCAL</b>	British Journal of Pharmacology and Chemotherapy. (London, UK) V.1-33, 1946-68. For publisher information, see BJPCBM.
<b>BMJOAE</b>	British Medical Journal. (British Medical Assoc., BMA House, Tavistock Sq., London WC1H 9JR, UK) V.1- 1857-
<b>BNYMAM</b>	

	Bulletin of the New York Academy of Medicine. (New York Academy of Medicine, 2 E. 103rd St., New York, NY 10029) Ser 2: V.1- 1925-
BRREAP	Brain Research. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1966-
CALEDQ	Cancer Letters (Shannon, Ireland). (Elsevier Scientific Pub. Ireland Ltd., POB 85, Limerick, Ireland) V.1- 1975-
CBCCT*	"Summary Tables of Biological Tests," National Research Council Chemical-Biological Coordination Center. (National Academy of Science Library, 2101 Constitution Ave., NW, Washington, DC 20418)
CFRGBR	Code of Federal Regulations. (U.S. Government Printing Office, Supt. of Documents, Washington, DC 20402)
CLPTAT	Clinical Pharmacology and Therapeutics. (American Society for Clinical Pharmacology and Therapeutics, St. Louis Mo Mosby-Year Book) V.1- 1960-
CNREA8	Cancer Research. (Public Ledger Building, Suit 816, 6th & Chestnut Sts., Philadelphia, PA 19106) V.1- 1941-
CRNGDP	Carcinogenesis (London). (Oxford Univ. Press, Pinkhill House, Southfield Road, Eynsham, Oxford OX8 1JJ, UK) V.1- 1980-
CRTXB2	CRC Critical Reviews in Toxicology. (CRC Press, Inc., 2000 Corporate Blvd., NW, Boca Raton, FL 33431) V.1- 1971-
DIMON*	Disease-a Month (Chicago : Year Book Publishers) V. 24- 1978-
DTLVS*	The Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) booklet issues by American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH, 1996
EMMUEG	Environmental and Molecular Mutagenesis. (Alan R. Liss, Inc., 41 E. 11th St., New York, NY 10003) V.10- 1987-
ENTOX*	Encyclopedia of Toxicology: Reference Book, Elsevier, 2005
ENVRAL	Environmental Research. (Academic Press, Inc., 1 E. First St., Duluth, MN 55802) V.1- 1967-
ETOPFR	Environmental Toxicology and Pharmacology (Elsevier Science, P.O.Box 7247-7682, Philadelphia, PA 19170 -7682, USA OR Elsevier Science B.V., P.O.Box 1270, 1000 BG Amsterdam, The Netherlands) V.1- Feb.1996-
ETPAEK	

	Experimental and Toxicologic Pathology. (Gustav Fischer Verlag Jena, Postfach 100537, D-07705 Jena, Germany) V.44- 1992-
EVHPAZ	EHP, Environmental Health Perspectives. (U.S. Government Printing Office, Supt of Documents, Washington, DC 20402) No.1- 1972-
FAATDF	Fundamental and Applied Toxicology. (Academic Press, Inc., 1 E. First St., Duluth, MN 55802) V.1-40, 1981-97. For publisher information, see TOSCF2
FAONAU	FAO Nutrition Meetings Report Series. (Rome, Italy) No.?-57, 1948-77. Discontinued.
FCTOD7	Food and Chemical Toxicology. (Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, NY 10523) V.20- 1982-
FNSCA6	Forensic Science. (Lausanne, Switzerland) V.1-11, 1972-78. For publisher information, see FSI NDR.
GTPZAB	Gigiena Truda i Professional'nye Zabolevaniya. Labor Hygiene and Occupational Diseases. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1-36, 1957-1992. For publisher information, see MTPEEI
HBTXAC	"Handbook of Toxicology," 4 vols., Philadelphia, W.B. Saunders Co., 1956-59
HETOEAE	Human & Experimental Toxicology. (Macmillan Press Ltd., Brunel Road, Houndmills, Basingstoke, Hampshire, RG21 2XS, UK) V.9- 1990-
HUTOX*	
IMEMDT	IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man. (WHO Publications Centre USA, 49 Sheridan Ave., Albany, NY 12210) V.1- 1972-
IMSUDL	IARC Monographs, Supplement. (WHO Publications Centre USA, 49 Sheridan Ave., Albany, NY 12210) No.1- 1979-
INHEAO	Industrial Health. (National Institute of Industrial Health, 6-21-1 Nagao, Tama-ku, Kawasaki, 213 Japan) V.1- 1963-
ITCSAF	In Vitro. (Rockville, MD) V.1-20, 1965-85. For publisher information, see ICDBEO.
JAPTO*	Journal of Applied Toxicology (John Wiley & Sons, Ltd., Oldlands Way Bognor Regis West Sussex, PO22 9SA England) V.1- 1981-
JEPTDQ	

	Journal of Environmental Pathology and Toxicology. (Park Forest South, IL) V.1-5(3), 1977-81(?). For publisher information, see JEPOEC.
JIHTAB	Journal of Industrial Hygiene and Toxicology. (Cambridge, MA) V.18-31, 1936-49. For publisher information, see AEHLAU.
JJATDK	JAT, Journal of Applied Toxicology. (John Wiley & Sons Ltd., Baffins Lane, Chichester, W. Sussex PO19 1UD, UK) V.1- 1981-
JJOMDZ	JOM, Journal of Occupational Medicine. (American Occupational Medicine Assoc., 150 N. Wacker Dr., Chicago, IL 60606) V.10-1968-
JPETAB	Journal of Pharmacology and Experimental Therapeutics. (Williams & Wilkins Co., 428 E. Preston St., Baltimore, MD 21202) V.1- 1909/10-
JPHYA7	Journal of Physiology. (Cambridge Univ. Press, 32 E. 57th St., New York, NY 10022) V.1- 1878-
JTCTDW	Journal of Toxicology, Clinical Toxicology. (Marcel Dekker, 270 Madison Ave., New York, NY 10016) V.19- 1982-
JTEHD6	Journal of Toxicology and Environmental Health. (Hemisphere Pub., 1025 Vermont Ave., NW, Washington, DC 20005) V.1-1975/76-
JTPAE7	Journal of Toxicologic Pathology. (Nihon Dokusei Byori Gakkai, editor, 3-25-8 Nishi- shinbashi, Minato-ku, Tokyo 105, Japan) V.1-1988
MMWR**	MMWR. Morbidity and Mortality Weekly Report. (Centers for Disease Control, Atlanta, GA 30333) V.25(10)- 1976- for RTECS citation, only V.34(Suppl 1S), 1985 is used.
MUREAV	Mutation Research. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1964-
MUTAEX	Mutagenesis. (Oxford Univ. Press, Pinkhill House, Southfield Road, Eynsham, Oxford OX8 1JJ, UK) V.1- 1986-
NCITR*	National Cancer Institute Carcinogenesis Technical Report Series. (Bethesda, MD) No.0-205. For publisher information, see NTPTR*.
NEPADD	Neurochemical Pathology. (Humana Press Inc., 999 Riverview Dr., Suite 208, Totowa, NJ 07512) V.1- 1983-
NETEEC	Neurotoxicology and Teratology. (Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, NY 10523) V.9- 1987-
NIOSH*	

	National Institute of Occupational Safety and Health, U.S. Dept. of Health, Education, and Welfare, Reports and Memoranda.
<b>NRTXDN</b>	Neurotoxicology. (Intox Press, Inc., POB 34075, Little Rock, AR 72203) V.1- 1979-
<b>NTIS**</b>	National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific & Technical Information.
<b>NTOTDY</b>	Neurobehavioral Toxicology and Teratology. (Fayetteville, NY) V.3-8, 1981-86. For publisher information, see NETEEC.
<b>NTPTR*</b>	National Toxicology Program Technical Report Series. (Research Triangle Park, NC 27709) No.206-
<b>NZMJAX</b>	New Zealand Medical Journal. (New Zealand Medical Assoc., P.O. Box 156, Wellington, New Zealand) V.1- 1900-
<b>QJPPAL</b>	Quarterly Journal of Pharmacy & Pharmacology. (London, UK) V.2-21, 1929-48. For publisher information, see JPPMAB.
<b>REPTED</b>	Reproductive Toxicology. (Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, NY 10523) V.1- 1987-
<b>SCIEAS</b>	Science. (American Assoc. for the Advancement of Science, 1333 H St., NW, Washington, DC 20005) V.1- 1895-
<b>SWEHDO</b>	Scandinavian Journal of Work, Environment and Health. (Haartmaninkatu 1, SF-00290 Helsinki, 29, Finland) V.1- 1975-
<b>TECSDY</b>	Toxicological and Environmental Chemistry. (Gordon & Breach Science Pub. Inc., 1 Park Ave., New York, NY 10016) V.3(3/4)- 1981-
<b>TOLED5</b>	Toxicology Letters. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1977-
<b>TOSCF2</b>	Toxicological Sciences (Oxford University Press, 6277 Sea Harbor Drive, Orlando, FL 32887 ) V. 41, Jan. 1998-
<b>TOXID9</b>	Toxicologist. (Soc. of Toxicology, Inc., 475 Wolf Ledge Parkway, Akron, OH 44311) V.1- 1981-
<b>TXAPA9</b>	Toxicology and Applied Pharmacology. (Academic Press, Inc., 1 E. First St., Duluth, MN 55802) V.1- 1959-
<b>TXCYAC</b>	Toxicology. (Elsevier Scientific Pub. Ireland, Ltd., POB 85, Limerick, Ireland) V.1- 1973-
<b>VCVGH*</b>	"Vrednie chemichescie veshstva, galogenproisvodnie uglevodorodov". (Hazardous substances: Galogenated hydrocarbons) Bandman A.L. et al., Chimia, 1990.

Used as a vapor degreaser of fabricated metal parts, as a solvent and as a drug

NIOSH PROFILE (GRAIN HANDLERS), SRI, 2/77

NIOSH PROFILE (SOLDER, MANUFACTURE AND USE), FIRL, 4/78

**RTECS Compound Description:**

Agricultural Chemical

Tumorigen

Drug

Mutagen

Reproductive Effector

Human Data

Primary Irritant

**ALT CAS #: 52037-46-4**

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## Search the Pocket Guide

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Trichloroethylene					
Synonyms & Trade Names Ethylene trichloride, TCE, Trichloroethene, Trilene					
CAS No. 79-01-6		RTECS No. <a href="#">KX4550000 (/niosh-rtecs/KX456D70.html)</a>		DOT ID & Guide 1710 160 ( <a href="http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=160">http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=160</a> )  ( <a href="http://www.cdc.gov/Other/disclaimer.html">http://www.cdc.gov/Other/disclaimer.html</a> )	
Formula ClCH=CCl <sub>2</sub>		Conversion 1 ppm = 5.37 mg/m <sup>3</sup>		IDLH Ca [1000 ppm] See: <a href="#">79016 (/niosh/idlh/79016.html)</a>	
Exposure Limits <b>NIOSH REL</b> : Ca <a href="#">See Appendix A (nengapdx.html)</a> <a href="#">See Appendix C (nengapdx.html)</a> <b>OSHA PEL</b> <a href="#">(nengapdxg.html)</a> : TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)			Measurement Methods <b>NIOSH</b> <a href="#">1022  (/niosh/docs/2003-154/pdfs/1022.pdf)</a> , <a href="#">3800  (/niosh/docs/2003-154/pdfs/3800.pdf)</a> ; <b>OSHA</b> <a href="#">1001</a> ( <a href="http://www.osha.gov/dts/sltc/methods/mdt/mdt1001/1001.html">http://www.osha.gov/dts/sltc/methods/mdt/mdt1001/1001.html</a> )  ( <a href="http://www.cdc.gov/Other/disclaimer.html">http://www.cdc.gov/Other/disclaimer.html</a> ) See: <a href="#">NMAM (/niosh/docs/2003-154/)</a> or <a href="#">OSHA Methods</a> ( <a href="http://www.osha.gov/dts/sltc/methods/index.html">http://www.osha.gov/dts/sltc/methods/index.html</a> )  ( <a href="http://www.cdc.gov/Other/disclaimer.html">http://www.cdc.gov/Other/disclaimer.html</a> )		
Physical Description Colorless liquid (unless dyed blue) with a chloroform-like odor.					
MW: 131.4	BP: 189°F	FRZ: -99°F	Sol: 0.1%	VP: 58 mmHg	IP: 9.45 eV
Sp.Gr: 1.46	FLP: ?	UEL(77°F): 10.5%	LEL(77°F): 8%		
Combustible Liquid, but burns with difficulty.					
Incompatibilities & Reactivities Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)					
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact					
Symptoms irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]					
Target Organs Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system					
Cancer Site [in animals: liver & kidney cancer]					
Personal Protection/Sanitation (See protection codes ( <a href="#">protect.html</a> )) <b>Skin:</b> Prevent skin contact <b>Eyes:</b> Prevent eye contact			First Aid (See procedures ( <a href="#">firstaid.html</a> )) <b>Eye:</b> Irrigate immediately <b>Skin:</b> Soap wash promptly		

**Wash skin:** When contaminated  
**Remove:** When wet or contaminated  
**Change:** No recommendation  
**Provide:** Eyewash, Quick drench

**Breathing:** Respiratory support  
**Swallow:** Medical attention immediately

#### Respirator Recommendations

#### NIOSH

**At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:**

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

**Escape:**

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0081 \(/niosh/ipcsneng/neng0081.html\)](#) See MEDICAL TESTS: [0236 \(/niosh/docs/2005-110/nmed0236.html\)](#)

Page last reviewed: April 4, 2011

Page last updated: November 18, 2010

Content source: [National Institute for Occupational Safety and Health \(NIOSH\)](#) Education and Information Division

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## p-Dichlorobenzene

[Field Label Abbreviations & Descriptions](#)  
[OSHA Occupational Chemical Database](#)

**Literature Basis:**

NIOSH Pocket Guide to Chemical Hazards: [p-Dichlorobenzene](#).  
International Chemical Safety Cards (WHO/IPC/IL0): [1,4-Dichlorobenzene](#).  
Bogaards, J.J.P., van Ommen, B., Wolf, C.R. and van Bladeren, P.J.: Human cytochrome P450 enzyme selectivities in the oxidation of chlorinated benzenes. *Toxicol. Appl. Pharmacol.* 132(1): 44-52, 1995.  
Miyai, I., Hirano, N., Fujita, M. and Kameyama, M.: Reversible ataxia following chronic exposure to paradichlorobenzene. *J. Neurol. Neurosurg. Psychiatry* 51(3): 453-454, 1988.  
Pohanish, R.P. (editor): Dichlorobenzenes. In, *Sittig's Handbook of Toxic and Hazardous Chemicals and Carcinogens, Fourth Ed.*, Vol. 1. Norwich, NY: Noyes Publications, William Andrew Publishing, 2002, pp. 799-804.  
Rosas Vazquez, E., Campos Macias, P., Ochoa Tirado, J.G., Garcia Solana, C., Casanova, A. and Palomino Moncada, J.F.: Chloracne in the 1990s. *Int. J. Dermatol.* 35(9): 643-645, 1996.  
Yoshida, T., *et al.*: Inhalation toxicokinetics of p-dichlorobenzene and daily absorption and internal accumulation in chronic low-level exposure to humans. *Arch. Toxicol.* 76(5-6): 306-315, 2002.

**Date Last Revised:** 05/10/2005

**Monitoring Methods used by OSHA****Primary Laboratory Sampling/ Analytical Method (SLC1):**

**sampling media:** Charcoal Tube (100/50 mg sections, 20/40 mesh)  
**analytical solvent:** Carbon Disulfide  
**maximum volume:** 3 Liters  
**maximum flow rate:** 0.05 L/min (TWA)  
**maximum volume:** 3 Liters  
**maximum flow rate:** 0.2 L/min (STEL)  
**current analytical method:** Gas Chromatography; GC/FID  
**method reference:** NIOSH Analytical Method ([NIOSH 1003](#) [113 KB PDF, 7 pages])  
**method classification:** Partially Validated

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# Benzene, p - dichloro -

**RTECS #: CZ4550000**

**CAS #: 106-46-7**

UPDATE: May 2009	MW: 147.00	MF: C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub>
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## NOTE:

TOXICITY DATA HAVE NOT BEEN EVALUATED. OMISSION OF A SUBSTANCE OR NOTATION DOES NOT IMPLY ANY RELIEF FROM REGULATORY RESPONSIBILITY.

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## SYNONYMS:

- |                                    |                                      |
|------------------------------------|--------------------------------------|
| 1. 1,4 - Dichloorbenzeen (Dutch)   | 18. Paramoth                         |
| 2. 1,4 - Dichlor - benzol (German) | 19. Paranuggets                      |
| 3. 1,4 - Dichlorobenzene           | 20. Parazene                         |
| 4. 1,4 - Diclorobenzene (Italian)  | 21. Persia - perazol                 |
| 5. Di - chloricide                 | 22. RCRA waste number U070           |
| 6. Evola                           | 23. RCRA waste number U071           |
| 7. Globol                          | 24. RCRA waste number U072           |
| 8. NCI - C54955                    | 25. Santochlor                       |
| 9. PDB                             | 26. p - Chlorophenyl chloride        |
| 10. PDCB                           | 27. p - Dichloorbenzeen (Dutch)      |
| 11. Para crystals                  | 28. p - Dichlorbenzol (German)       |
| 12. Paracide                       | 29. p - Dichlorobenzene              |
| 13. Paradi                         | 30. p - Dichlorobenzene (ACGIH:OSHA) |
| 14. Paradichlorbenzol (German)     | 31. p - Dichlorobenzol               |
| 15. Paradichlorobenzene            | 32. p - Diclorobenzene (Italian)     |
| 16. Paradichlorobenzol             | 33. para - Chlorophenyl chloride     |
| 17. Paradow                        | 34. para - Dichlorobenzene           |

**SKIN AND EYE IRRITATION DATA AND REFERENCES:**

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE
eye human	80 ppm	N/R	<a href="#">AMIHAB</a> 14,138,1956

**MUTATION DATA AND REFERENCES:**

SYSTEM TEST	ROUTE/ ORGANISM/ TISSUE	DOSE	REFERENCE
DNA damage	intraperitoneal mouse	2 gm/kg	<a href="#">MUREAV</a> 391,201,1997
DNA repair	oral mouse	1,000 mg/kg	<a href="#">TCMUD8</a> 18,309,1998
DNA repair	oral rat	1,000 mg/kg	<a href="#">TCMUD8</a> 18,309,1998
mutation in microorganisms	Aspergillus nidulans	200 mg/L (-enzymatic activation step)	<a href="#">CJMIAZ</a> 16,369,1970
micronucleus test	intraperitoneal mouse	355 mg/kg/24 hour	<a href="#">MUTAEX</a> 2,111,1987
gene conversion and mitotic recombination	Saccharomyces cerevisiae	1 mmol/L	<a href="#">MUREAV</a> 413,205,1998
other mutation test systems	oral mouse	750 mg/kg	<a href="#">MUREAV</a> 343,157,1995
sister chromatid exchange	human lymphocyte	100 µg/L	<a href="#">MUREAV</a> 263,57,1991
sperm morphology	intraperitoneal rat	800 mg/kg	<a href="#">ACDSEL</a> 2,248,1985

**REPRODUCTIVE EFFECTS DATA AND REFERENCES:**

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE
inhalation rabbit	lowest published toxic concentration: 800 ppm/6 hour (6-18 day pregnant)	Reproductive: Specific developmental abnormalities: Cardiovascular (circulatory) system	<a href="#">FAATDF</a> 5,190,1985
oral rat	lowest published toxic dose: 7,500 mg/kg (6-15 day pregnant)	Reproductive: Specific developmental abnormalities: Musculoskeletal system	<a href="#">BECTA6</a> 37,164,1986
oral rat	lowest published toxic dose: 10 gm/kg (6-15 day pregnant)	Reproductive: Effects on embryo or fetus: Fetotoxicity (except death, e.g., stunted fetus)	<a href="#">BECTA6</a> 37,164,1986
oral rat	lowest published toxic dose: 84 mg/kg (1-21 day pregnant/21 day after birth)	Reproductive: Effects on newborn: Other postnatal measures or effects	<a href="#">BCLPT*</a> 95,139,2004

**TUMORIGENIC DATA AND REFERENCES:**

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE
oral mouse	lowest published toxic dose: 155 gm/kg/2 year - intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Liver: Tumors	<a href="#">NTPTR*</a> NTP-TR-319,1987
oral mouse	lowest published toxic dose: 309,000	Tumorigenic: Carcinogenic by RTECS criteria	<a href="#">NTIS**</a> PB87-208617/AS

	mg/kg/103 week- intermittent	Liver: Tumors	
oral mouse	lowest published toxic dose: 309,000 mg/kg/103 week- intermittent	Tumorigenic: Equivocal tumorigenic agent by RTECS criteria  Endocrine: Adrenal cortex tumors	<a href="#">NTIS**</a> PB87- 208617/AS
oral rat	lowest published toxic dose: 155 gm/kg/2 year- intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Kidney, Ureter, and Bladder: Kidney tumors	<a href="#">NTPTR*</a> NTP- TR-319,1987
oral rat	lowest published toxic dose: 77,250 mg/kg/13 week- intermittent	Tumorigenic: Carcinogenic by RTECS criteria  Kidney, Ureter, and Bladder: Kidney tumors	<a href="#">NTIS**</a> PB87- 208617/AS

### ACUTE TOXICITY DATA AND REFERENCES:

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE
inhalation cat	lowest published lethal concentration: 37 gm/m <sup>3</sup> /30 minute	Behavioral: General anesthetic	<a href="#">YKYUA6</a> 38,1045,1987
inhalation human	lowest published toxic concentration: 480 mg/m <sup>3</sup>	Eye: Conjunctiva irritation	<a href="#">VCVGK*</a> -,24,1984

		<b>Olfaction: Other olfaction effects</b>	
inhalation mammal (species unspecified)	lethal concentration (50 percent kill): 12 gm/m <sup>3</sup>	N/R	<a href="#">GTPZAB 32</a> (10),25,1988
inhalation rat	lethal concentration (50 percent kill): 5,000 mg/m <sup>3</sup> /4 hour	N/R	<a href="#">BFUUA*</a> 185,1,1996
intraperitoneal mouse	lethal dose (50 percent kill): 2 gm/kg	N/R	<a href="#">MUTAEX</a> 2,111,1987
intraperitoneal rat	lethal dose (50 percent kill): 2,562 mg/kg	N/R	<a href="#">JAPMA8</a> 38,124,1949
intraperitoneal rat	lowest published toxic dose: 4 mg/kg	Liver: Changes in liver weight	<a href="#">TXAPA9</a> 111,69,1991
intraperitoneal rat	lowest published toxic dose: 1 mg/kg	Kidney, Ureter, and Bladder: Changes in tubules (including acute renal failure, acute tubular necrosis)	<a href="#">TXAPA9</a> 111,69,1991
intraperitoneal rat	lowest published toxic dose: 2 mg/kg	Endocrine: Evidence of thyroid hypofunction	<a href="#">TXAPA9</a> 111,69,1991
oral guinea pig	lowest published lethal dose: 2,800 mg/kg	N/R	<a href="#">AMIHAB</a> 14,138,1956
oral human	lowest published toxic dose: 300 mg/kg	Eye: Other eye effects  Lung, Thorax, or Respiration: Other changes  Gastrointestinal: Hypermotility, diarrhea	<a href="#">PCOC**</a> -,851,1966
oral human		N/R	<a href="#">34ZIAG</a> -,210,1969

	lowest published lethal dose: 857 mg/kg		
oral mammal (species unspecified)	lethal dose (50 percent kill): 2,600 mg/kg	N/R	<a href="#">GTPZAB 32</a> (10),25,1988
oral mouse	lethal dose (50 percent kill): 2,950 mg/kg	N/R	<a href="#">GUHAZ</a> 6,183,1973
oral rat	lethal dose (50 percent kill): 500 mg/kg	N/R	<a href="#">WRPCA2</a> 9,119,1970
oral rabbit	lethal dose (50 percent kill): 2,830 mg/kg	N/R	<a href="#">YKYUA6</a> 29,453,1978
subcutaneous mouse	lethal dose (50 percent kill): 5,145 mg/kg	Behavioral: Tremor	<a href="#">TOIZAG</a> 20,772,1973
skin rat	lethal dose (50 percent kill): 2,000 mg/kg	N/R	<a href="#">BFUUA*</a> 185,1,1996
skin rabbit	lethal dose (50 percent kill): >2 gm/kg	N/R	<a href="#">SPEADM</a> 78-1,18,1978
unreported route human	lowest published lethal dose: 357 mg/kg	N/R	<a href="#">YKYUA6</a> 31,1499,1980
unreported route man	lowest published lethal dose: 221 mg/kg	N/R	<a href="#">85DCAI</a> 2,73,1970

## OTHER MULTIPLE DOSE DATA AND REFERENCES:

ROUTE/ ORGANISM	DOSE	EFFECT	REFERENCE
--------------------	------	--------	-----------

inhalation guinea pig	lowest published toxic concentration: 158 ppm/7 hour/31 week- intermittent	Liver: Changes in liver weight	<a href="#">AMIHAB</a> 14,138,1956
inhalation guinea pig	lowest published toxic concentration: 100 gm/m <sup>3</sup> /20 minute/20 day- intermittent	Blood: Granulocytopenia  Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">JAPMA8</a> 38,124,1949
inhalation rat	lowest published toxic concentration: 158 ppm/7 hour/31 week- intermittent	Liver: Changes in liver weight  Kidney, Ureter, and Bladder: Changes in bladder weight	<a href="#">AMIHAB</a> 14,138,1956
inhalation rat	lowest published toxic concentration: 100 gm/m <sup>3</sup> /20 minute/25 day- intermittent	Behavioral: General anesthetic  Behavioral: Tremor  Blood: Granulocytopenia	<a href="#">JAPMA8</a> 38,124,1949
inhalation rat	lowest published toxic concentration: 140 ppm/6 hour/2 year- intermittent	Olfaction: Other olfaction effects  Kidney, Ureter, and Bladder: Other changes	<a href="#">JTSCDR</a> 22,357,1997
inhalation rat	lowest published toxic concentration: 950 mg/m <sup>3</sup> /7 hour/22 week- intermittent	Liver: Other changes	<a href="#">VCVGK*</a> -,24,1994
inhalation rabbit	lowest published toxic concentration: 100 gm/m <sup>3</sup> /30	Olfaction: Other olfaction effects  Eye: Other eye effects	<a href="#">JAPMA8</a> 38,124,1949

	minute/31 day-intermittent	Blood: Granulocytopenia	
oral mouse	lowest published toxic dose: 58,500 mg/kg/13 week-intermittent	<p>Liver: Hepatitis (hepatocellular necrosis), zonal</p> <p>Kidney, Ureter, and Bladder: Changes in bladder weight</p> <p>Blood: Changes in leukocyte (WBC) count</p>	<a href="#">NTPTR*</a> NTP-TR-319,1987
oral mouse	lowest published toxic dose: 3 gm/kg/1 week-intermittent	<p>Liver: Other changes</p> <p>Liver: Changes in liver weight</p> <p>Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Hepatic microsomal mixed oxidase (dealkylation, hydroxylation, etc.)</p>	<a href="#">FAATDF</a> 39,67,1997
oral mouse	lowest published toxic dose: 3 gm/kg/7 day-continuous	<p>Liver: Other changes</p> <p>Liver: Changes in liver weight</p> <p>Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: Cytochrome oxidases (including oxidative phosphorylation)</p>	<a href="#">EVHPAZ</a> 110,363,2002
oral rat	lowest published toxic dose: 14 gm/kg/14 day-intermittent	Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">NTPTR*</a> NTP-TR-319,1987
oral rat	lowest published toxic dose: 58,500	Liver: Changes in liver weight	<a href="#">NTPTR*</a> NTP-TR-319,1987

	mg/kg/13 week-intermittent	Kidney, Ureter, and Bladder: Changes in tubules (including acute renal failure, acute tubular necrosis)  Blood: Changes in erythrocyte (RBC) count	
oral rat	lowest published toxic dose: 10 gm/kg/4 week-intermittent	Liver: Hepatitis (hepatocellular necrosis), zonal  Kidney, Ureter, and Bladder: Changes in tubules (including acute renal failure, acute tubular necrosis)	<a href="#">AMIHAB</a> 14,138,1956
oral rat	lowest published toxic dose: 750 mg/kg/7 day-continuous	Kidney, Ureter, and Bladder: Other changes  Kidney, Ureter, and Bladder: Changes in kidney weight	<a href="#">EVHPAZ</a> 110,363,2002
oral rat	lowest published toxic dose: 9 gm/kg/90 day-continuous	Liver: Other changes  Liver: Changes in liver weight  Kidney, Ureter, and Bladder: Changes in kidney weight	<a href="#">EVHPAZ</a> 110,363,2002
oral rat	lowest published toxic dose: 18 gm/kg/90 day-continuous	Liver: Other changes  Liver: Changes in liver weight	<a href="#">EVHPAZ</a> 110,363,2002
oral rat	lowest published toxic dose: 90 mg/kg/3 day-intermittent	Kidney, Ureter, and Bladder: Other changes  Biochemical: Metabolism	<a href="#">TXCYAC</a> 180,233,2002

		(intermediary): Other proteins	
oral rabbit	lowest published toxic dose: 92 gm/kg/31 week-intermittent	Behavioral: Tremor  Related to Chronic Data: Death in the "MULTIPLE DOSE" data type field	<a href="#">AMIHAB</a> 14,138,1956
unreported route rat	lowest published toxic dose: 8,400 mg/kg/28 day-intermittent	Kidney, Ureter, and Bladder: Other changes	<a href="#">TOXID9</a> 66,62,2002

## REVIEWS:

ORGANIZATION	STANDARD	REFERENCE
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value	time-weighted average 10 ppm	<a href="#">DTLVS*</a> TLV/BEI,2007
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value	Confirmed animal carcinogen	<a href="#">DTLVS*</a> TLV/BEI,2007
International Agency for Research on Cancer (IARC) Cancer Review	Animal Sufficient Evidence	<a href="#">IMSUDL</a> 7,192,1987
International Agency for Research on Cancer (IARC) Cancer Review	Animal Sufficient Evidence	<a href="#">IMEMDT</a> 73,223,1999
International Agency for Research on Cancer (IARC) Cancer Review	Human Inadequate Evidence	<a href="#">IMEMDT</a> 7,231,1974
International Agency for Research on Cancer (IARC) Cancer Review	Animal Inadequate Evidence	<a href="#">IMEMDT</a> 7,231,1974
International Agency for Research on Cancer (IARC) Cancer Review	Human Inadequate Evidence	<a href="#">IMEMDT</a> 29,213,1982

International Agency for Research on Cancer (IARC) Cancer Review	Animal Inadequate Evidence	<a href="#">IMEMDT</a> 29,213,1982
International Agency for Research on Cancer (IARC) Cancer Review	Human Inadequate Evidence	<a href="#">IMEMDT</a> 73,223,1999
International Agency for Research on Cancer (IARC) Cancer Review	Group 2B	<a href="#">IMEMDT</a> 73,223,1999
TOXICOLOGY REVIEW		<a href="#">TOLED5</a> 127,111,2002
TOXICOLOGY REVIEW		<a href="#">MUREAV</a> 543,201,2003
TOXICOLOGY REVIEW		<a href="#">MUREAV</a> 543,201,2003
TOXICOLOGY REVIEW		<a href="#">TXCYAC</a> 196,1,2004
TOXICOLOGY REVIEW		<a href="#">MUREAV</a> 613,17,2006
TOXICOLOGY REVIEW		<a href="#">ENTOX*</a> -,5,2005
TOXICOLOGY REVIEW		<a href="#">MUREAV</a> 627,59,2007
TOXICOLOGY REVIEW		<a href="#">MUREAV</a> 654,114,2008
TOXICOLOGY REVIEW		<a href="#">MUREAV</a> 654,114,2008
TOXICOLOGY REVIEW		<a href="#">JTPAE7</a> 19,111,2006

## STANDARDS AND REGULATIONS:

ORGANIZATION	STANDARD	REFERENCE

Environmental Protection Agency (EPA) Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) 1988	PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION	<a href="#">FEREAC</a> 54,7740,1989
Environmental Protection Agency (EPA) Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) 1998 STATUS OF	PESTICIDES: Supported	<a href="#">RBREV*</a> -,250,1998
Mine Safety and Health Administration (MSHA) STANDARD - air	time-weighted average 75 ppm (450 mg/m <sup>3</sup> )	<a href="#">DTLVS*</a> 3,77,1971
Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (General Industry)	8 hour time-weighted average 75 ppm (450 mg/m <sup>3</sup> )	<a href="#">CFRGBR</a> 29,1910.1000,1994
Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (Construction)	8 hour time-weighted average 75 ppm (450 mg/m <sup>3</sup> )	<a href="#">CFRGBR</a> 29,1926.55,1994
Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (Shipyards)	8 hour time-weighted average 75 ppm (450 mg/m <sup>3</sup> )	<a href="#">CFRGBR</a> 29,1915.1000,1993
Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (Federal Contractors)	8 hour time-weighted average 75 ppm (450 mg/m <sup>3</sup> )	<a href="#">CFRGBR</a> 41,50-204.50,1994
Occupational Exposure Limit - AUSTRALIA	time-weighted average 25 ppm (150 mg/m <sup>3</sup> ), short term exposure limit 50 ppm (300 mg/m <sup>3</sup> ), JUL 2008	
Occupational Exposure Limit - BELGIUM	time-weighted average 10 ppm (61 mg/m <sup>3</sup> ), short term exposure limit 50 ppm (306 mg/m <sup>3</sup> ), MAR2002	
Occupational Exposure Limit - DENMARK	time-weighted average 10 ppm (60 mg/m <sup>3</sup> ), OCT 2002	
Occupational Exposure Limit - EC		

	time-weighted average 122 mg/m <sup>3</sup> (20 ppm); short term exposure limit 306 mg/m <sup>3</sup> (50 ppm), FEB 2006
Occupational Exposure Limit - FINLAND	time-weighted average 75 ppm (450 mg/m <sup>3</sup> ), short term exposure limit 115 ppm (690 mg/m <sup>3</sup> ), Skin, JAN1999
Occupational Exposure Limit - FRANCE	VME 0.75 ppm (4.5 mg/m <sup>3</sup> ), VLE 50 ppm (306 mg/m <sup>3</sup> ), continuous <sup>3</sup> Carcinogen, FEB2006
Occupational Exposure Limit - HUNGARY	time-weighted average 122 mg/m <sup>3</sup> , short term exposure limit 306 mg/m <sup>3</sup> , SEP2000
Occupational Exposure Limit - JAPAN	Occupational Exposure Limit 10 ppm (60 mg/m <sup>3</sup> ), 2B carcinogen, APR2007
Occupational Exposure Limit - KOREA	time-weighted average 75 ppm (450 mg/m <sup>3</sup> ), short term exposure limit 110 ppm (675 mg/m <sup>3</sup> ), 2006
Occupational Exposure Limit - MEXICO	time-weighted average 75 ppm (450 mg/m <sup>3</sup> ); short term exposure limit 110 ppm (675 mg/m <sup>3</sup> ), 2004
Occupational Exposure Limit - THE NETHERLANDS	MAC-TGG 150 mg/m <sup>3</sup> , 2003
Occupational Exposure Limit - NEW ZEALAND	time-weighted average 25 ppm (153 mg/m <sup>3</sup> ); short term exposure limit 50 ppm (306 mg/m <sup>3</sup> ), JAN2002
Occupational Exposure Limit - THE PHILIPPINES	time-weighted average 75 ppm (450 mg/m <sup>3</sup> ), JAN1993
Occupational Exposure Limit - POLAND	MAC(time-weighted average) 20 mg/m <sup>3</sup> , JAN1999
Occupational Exposure Limit - RUSSIA	time-weighted average 50 ppm, JUN2003
Occupational Exposure Limit - SWEDEN	time-weighted average 10 ppm (60 mg/m <sup>3</sup> ); short term exposure limit 20 ppm (120 mg/m <sup>3</sup> ), JUN2005
Occupational Exposure Limit - SWITZERLAND	MAK- week 20 ppm, DEC2006

Occupational Exposure Limit - TURKEY	time-weighted average 75 ppm (450 mg/m <sup>3</sup> ), JAN1993
Occupational Exposure Limit - UNITED KINGDOM	time-weighted average 25 ppm (153 mg/m <sup>3</sup> ); short term exposure limit 50 ppm, 2005
Occupational Exposure Limit IN ARGENTINA, BULGARIA, COLOMBIA, JORDAN	American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value;  Confirmed animal carcinogen
Occupational Exposure Limit IN SINGAPORE, VIETNAM	American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value Confirmed animal carcinogen

## NIOSH DOCUMENTATION AND SURVEILLANCE:

ORGANIZATION	STANDARD or SURVEY	REFERENCE
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Level TO p-DICHLOROBENZENE-air	Carcinogen (1.7 ppm LOQ)	<a href="#">NIOSH*</a> DHHS #92-100,1992
National Occupational Hazard Survey 1974	National Occupational Hazard Survey 1974: Hazard Code: 24006; Number of Industries 21; Total Number of Facilities 1,963; Number of Occupations 18; Total Number of Employees Exposed 23,116	
National Occupational Exposure Survey 1983	<a href="#">National Occupational Exposure Survey 1983: Hazard Code: 24006</a> <small>EXIT</small> ; Number of Industries 22; Total Number of Facilities 2,629; Number of Occupations 21; Total Number of Employees Exposed	

<b>33,978; Total Number of Female Employees Exposed 9,412</b>
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## STATUS IN FEDERAL AGENCIES:

ORGANIZATION	REFERENCE
ATSDR TOXICOLOGY PROFILE (NTIS** PB/99/121972)	
EPA TSCA Section 8(b) CHEMICAL INVENTORY	
EPA TSCA 8(a) PRELIMINARY ASSESSMENT INFORMATION, FINAL RULE	<a href="#">FEREAC</a> 47,26992,82
Used as a moth repellant, a mildew control agent and a space deodorant	
EPA TSCA Section 8(d) unpublished health/safety studies	
EPA TSCA Section 8(e) Risk Notification, 8EHQ-0892-9004	
On EPA IRIS database	
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 2001	
NIOSH Analytical Method, 1994: Hydrocarbons, halogenated, 1003	
NIOSH Analytical Method, 1996: Volatile organic compound, 2549	
NCI Carcinogenesis Studies (gavage); clear evidence: mouse, rat	
NTP 11th Report on Carcinogens, 2004: Reasonably anticipated to be a human carcinogen	

## REFERENCES:

CODEN	REFERENCE
34ZIAG	"Toxicology of Drugs and Chemicals," Deichmann, W.B., New York, Academic Press, Inc., 1969

<b>85DCAI</b>	"Poisoning; Toxicology, Symptoms, Treatments," 2nd ed., Arena, J.M., Springfield, IL, C.C. Thomas, 1970
<b>ACDSEL</b>	Advances in Contraceptive Delivery Systems. (Reproductive Health Center, 78 Surfsong Rd., Kiawah Island, SC 29455) V.1- 1985-
<b>AMIHAB</b>	AMA Archives of Industrial Health. (Chicago, IL) V.11-21, 1955-60. For publisher information, see AEHLAU.
<b>BCLPT*</b>	Basic & clinical pharmacology & toxicology (Copenhagen, Denmark : Nordic Pharmacological Society Oxford, UK : Distributed by Blackwell Munksgaard) V.94- 2004-
<b>BECTA6</b>	Bulletin of Environmental Contamination and Toxicology. (Springer-Verlag New York, Inc., Service Center, 44 Hartz Way, Secaucus, NJ 07094) V.1- 1966-
<b>BFUUA*</b>	Beratergremium fuer umweltrelevante Altstoffe (BUA. Gesellschaft Deutscher Chemiker. Weinheim ; New York : VCH) 1992-
<b>CFRGBR</b>	Code of Federal Regulations. (U.S. Government Printing Office, Supt. of Documents, Washington, DC 20402)
<b>CJMIAZ</b>	Canadian Journal of Microbiology. (National Research Council of Canada, Publication Sales and Distribution, Ottawa ON K1A 0R6, Canada) V.1- 1954-
<b>DTLVS*</b>	The Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) booklet issues by American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, OH, 1996
<b>ENTOX*</b>	Encyclopedia of Toxicology: Reference Book, Elsevier, 2005
<b>EVHPAZ</b>	EHP, Environmental Health Perspectives. (U.S. Government Printing Office, Supt of Documents, Washington, DC 20402) No.1- 1972-
<b>FAATDF</b>	Fundamental and Applied Toxicology. (Academic Press, Inc., 1 E. First St., Duluth, MN 55802) V.1-40, 1981-97. For publisher information, see TOSCF2
<b>FEREAC</b>	Federal Register. (U.S. Government Printing Office, Supt. of Documents, Washington, DC 20402) V.1- 1936-
<b>GTPZAB</b>	Gigiena Truda i Professional'nye Zabolevaniya. Labor Hygiene and Occupational Diseases. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1-36, 1957-1992. For publisher information, see MTPEEI
<b>GUHAZ</b>	Guide to the Chemicals Used in Crop Protection. (Information Canada, 171 Slater St., Ottawa, Ont., Canada)

<b>IMEMDT</b>	<b>IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man. (WHO Publications Centre USA, 49 Sheridan Ave., Albany, NY 12210) V.1- 1972-</b>
<b>IMSUDL</b>	<b>IARC Monographs, Supplement. (WHO Publications Centre USA, 49 Sheridan Ave., Albany, NY 12210) No.1- 1979-</b>
<b>JAPMA8</b>	<b>Journal of the American Pharmaceutical Association, Scientific Edition. (Washington, DC) V.29-49, 1940-60. For publisher information, see JPM SAE.</b>
<b>JTPAE7</b>	<b>Journal of Toxicologic Pathology. (Nihon Dokusei Byori Gakkai, editor, 3-25-8 Nishi- shinbashi, Minato-ku, Tokyo 105, Japan) V.1- 1988</b>
<b>JTSCDR</b>	<b>Journal of Toxicological Sciences. (Japanese Soc. of Toxicological Sciences, 4th Floor, Gakkai Center Bldg., 4-16, Yayoi 2-chome, Bunkyo-ku, Tokyo 113, Japan) V.1- 1976-</b>
<b>MUREAV</b>	<b>Mutation Research. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1964-</b>
<b>MUTAEX</b>	<b>Mutagenesis. (Oxford Univ. Press, Pinkhill House, Southfield Road, Eynsham, Oxford OX8 1JJ, UK) V.1- 1986-</b>
<b>NIOSH*</b>	<b>National Institute of Occupational Safety and Health, U.S. Dept. of Health, Education, and Welfare, Reports and Memoranda.</b>
<b>NTIS**</b>	<b>National Technical Information Service. (Springfield, VA 22161) Formerly U.S. Clearinghouse for Scientific &amp; Technical Information.</b>
<b>NTPTR*</b>	<b>National Toxicology Program Technical Report Series. (Research Triangle Park, NC 27709) No.206-</b>
<b>PCOC**</b>	<b>Pesticide Chemicals Official Compendium, Association of the American Pesticide Control Officials, Inc., 1966. (Topeka, KS)</b>
<b>RBREV*</b>	<b>Status of Pesticides in Registration, Reregistration, and Special Review (Rainbow Report), Special Review and Reregistration Division Office of Pesticide Programs U.S. Environmental Protection Agency, 401 M. Street, S.W., Washington, D.C. 20460, Spring 1998</b>
<b>SPEADM</b>	<b>Special Publication of the Entomological Society of America. (4603 Calvert Rd., College Park, MD 20740)</b>
<b>TCMUD8</b>	<b>Teratogenesis, Carcinogenesis, and Mutagenesis. (Alan R. Liss, Inc., 41 E. 11th St., New York, NY 10003) V.1- 1980-</b>
<b>TOIZAG</b>	

	Toho Igakkai Zasshi. Journal of Medical Society of Toho University. (Toho Daigaku Igakkai, 21-16, Omori-nishi, 5-chome, Ota-ku, Tokyo 143, Japan) V.1- 1954-
TOLED5	Toxicology Letters. (Elsevier Science Pub. B.V., POB 211, 1000 AE Amsterdam, Netherlands) V.1- 1977-
TOXID9	Toxicologist. (Soc. of Toxicology, Inc., 475 Wolf Ledge Parkway, Akron, OH 44311) V.1- 1981-
TXAPA9	Toxicology and Applied Pharmacology. (Academic Press, Inc., 1 E. First St., Duluth, MN 55802) V.1- 1959-
TXCYAC	Toxicology. (Elsevier Scientific Pub. Ireland, Ltd., POB 85, Limerick, Ireland) V.1- 1973-
VCVGK*	"Vrednie chemicheskije veshestva, galogen i kislorod sodergashie organicheskie soedinenia". (Hazardous substances. Galogen and oxygen containing substances), Bandman A.L. et al., Chimia, 1994.
WRPCA2	World Review of Pest Control. (London, UK) V.1-10, 1962-71. Discontinued.
YKYUA6	Yakkyoku. Pharmacy. (Nanzando, 4-1-11, Yushima, Bunkyo-ku, Tokyo, Japan) V.1- 1950-

Used as a moth repellant, a mildew control agent and a space deodorant

**RTECS Compound Description:**

Agricultural Chemical  
Tumorigen  
Mutagen  
Reproductive Effector  
Human Data  
Primary Irritant

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## Search the Pocket Guide

Enter search terms separated by spaces.

p-Dichlorobenzene					
Synonyms & Trade Names p-DCB; 1,4-Dichlorobenzene; para-Dichlorobenzene; Dichlorocide					
CAS No. 106-46-7		RTECS No. CZ4550000 (/niosh-rtecs/CZ456D70.html)		DOT ID & Guide	
Formula C6H4Cl2		Conversion 1 ppm = 6.01 mg/m3		IDLH Ca [150 ppm] See: 106467 (/niosh/idlh/106467.html)	
Exposure Limits NIOSH REL : Ca See Appendix A (nengapdx.html) OSHA PEL (nengapdxg.html) : TWA 75 ppm (450 mg/m3)			Measurement Methods NIOSH 1003 (/niosh/docs/2003-154/pdfs/1003.pdf) ; OSHA 7 (http://www.osha.gov/dts/sltc/methods/organic/org001/org001.html) (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description Colorless or white crystalline solid with a mothball-like odor. [insecticide]					
MW: 147.0	BP: 345°F	MLT: 128°F	Sol: 0.008%	VP: 1.3 mmHg	IP: 8.98 eV
Sp.Gr: 1.25	FLP: 150°F	UEL: ?	LEL: 2.5%		
Combustible Solid, but may take some effort to ignite.					
Incompatibilities & Reactivities Strong oxidizers (such as chlorine or permanganate)					
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact					
Symptoms Eye irritation, swelling periorbital (situated around the eye); profuse rhinitis; headache, anorexia, nausea, vomiting; weight loss, jaundice, cirrhosis; in animals: liver, kidney injury; [potential occupational carcinogen]					
Target Organs Liver, respiratory system, eyes, kidneys, skin					
Cancer Site [in animals: liver & kidney cancer]					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated/Daily Remove: When wet or contaminated			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap wash Breathing: Respiratory support Swallow: Medical attention immediately		

**Change:** Daily  
**Provide:** Eyewash, Quick drench

#### Respirator Recommendations

### NIOSH

**At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:**

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

**Escape:**

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0037 \(/niosh/ipcsneng/neng0037.html\)](#) See MEDICAL TESTS: [0073 \(/niosh/docs/2005-110/nmed0073.html\)](#)

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Content source: [National Institute for Occupational Safety and Health \(NIOSH\)](#) Education and Information Division

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800-CDC-INFO (800-232-4636) TTY: (888) 232-6348 - [Contact CDC-INFO](#)



**ATTACHMENT 2**

